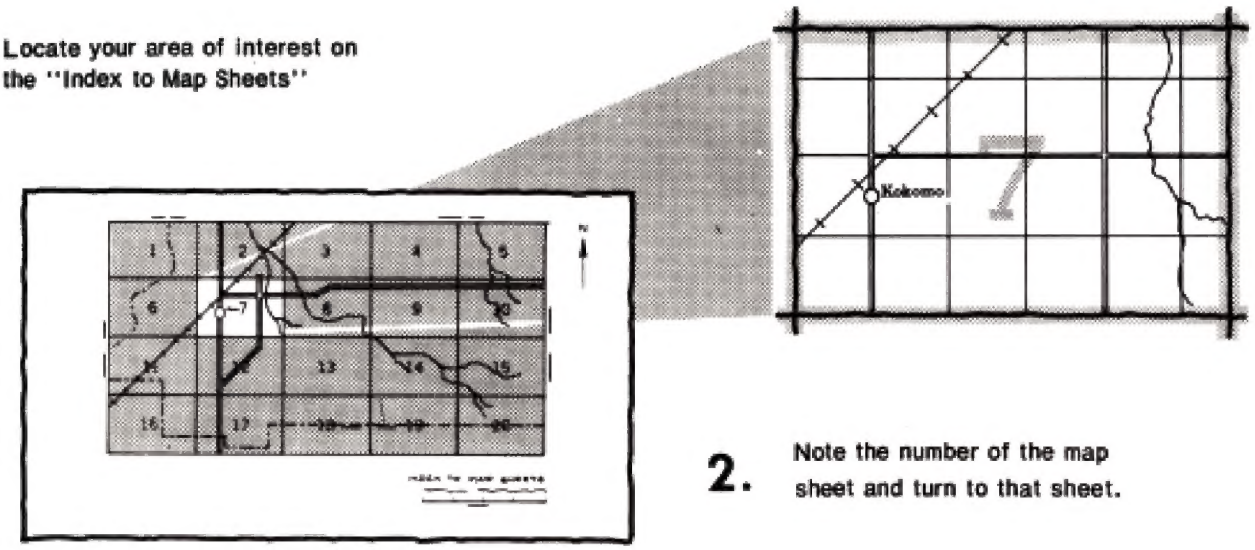
Soil survey of

MILLS COUNTY IOWA

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Iowa Agriculture and Home Economics Experiment Station
Cooperative Extension Service, Iowa State University, and
Department of Soil Conservation, State of Iowa

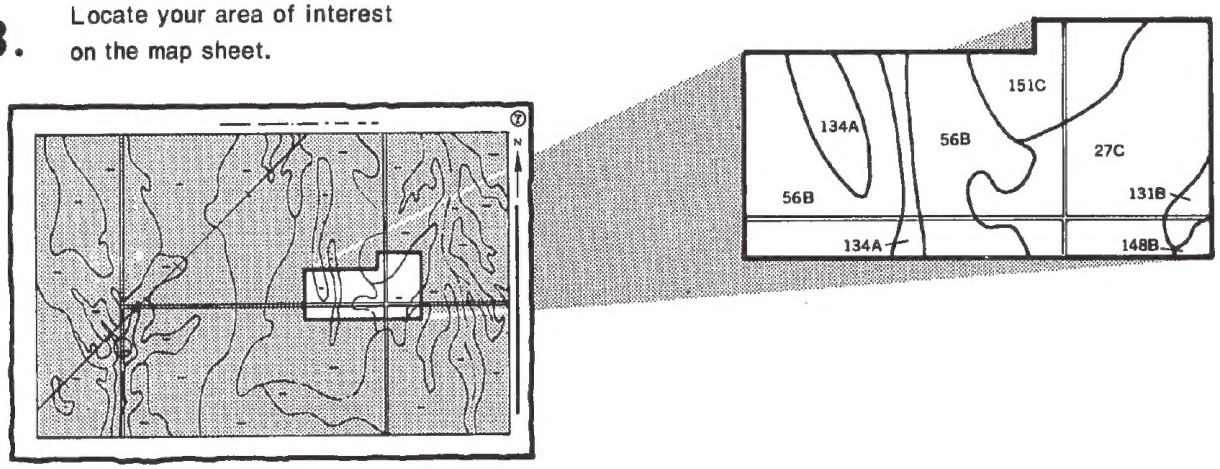
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

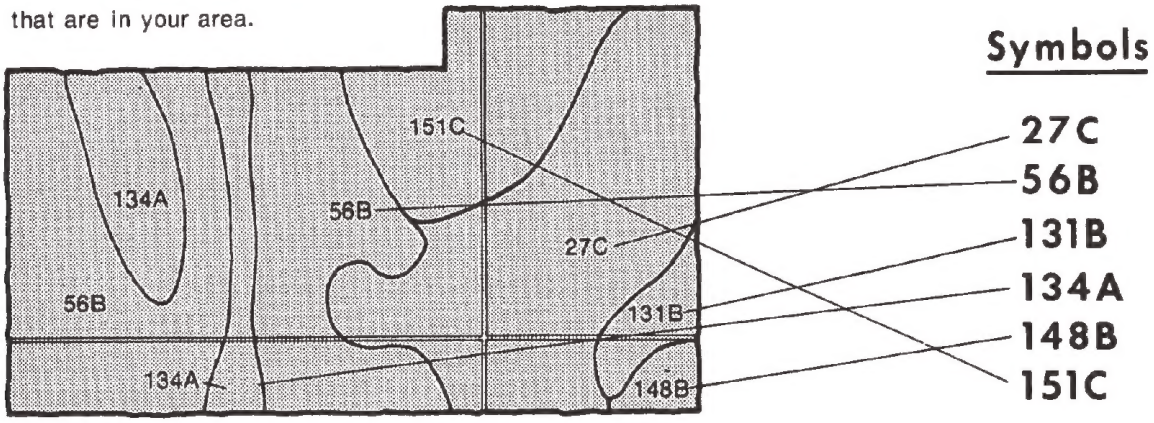


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

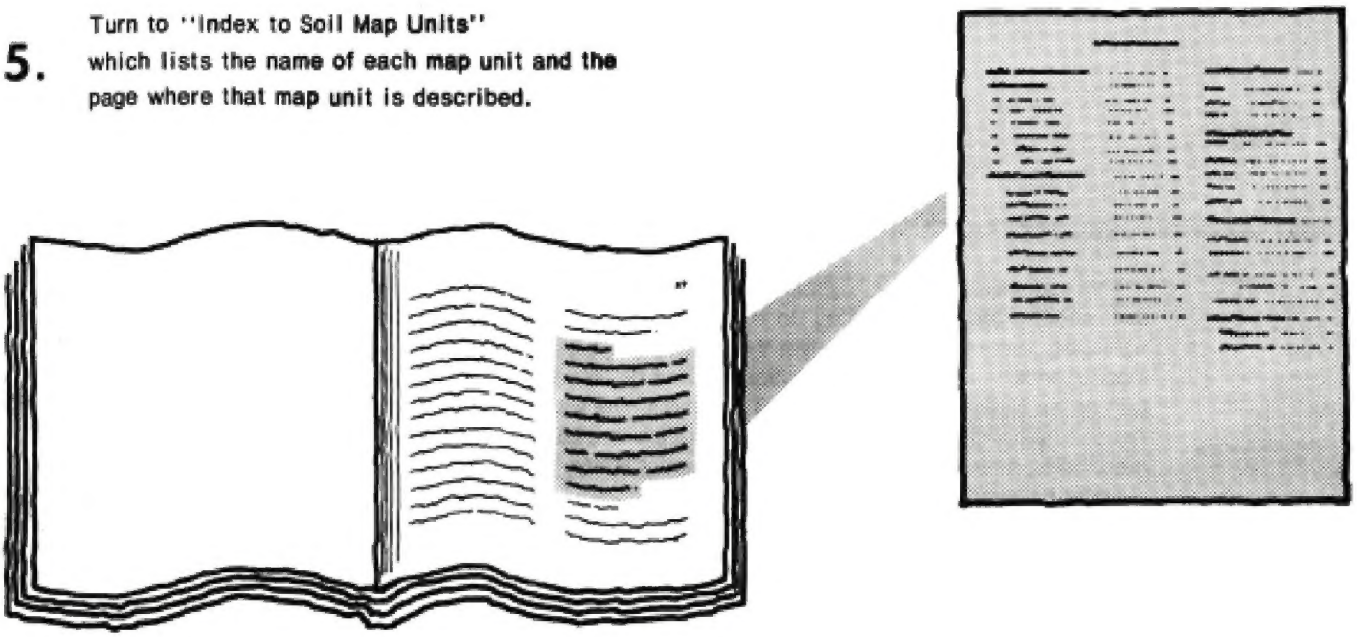


4. List the map unit symbols that are in your area.

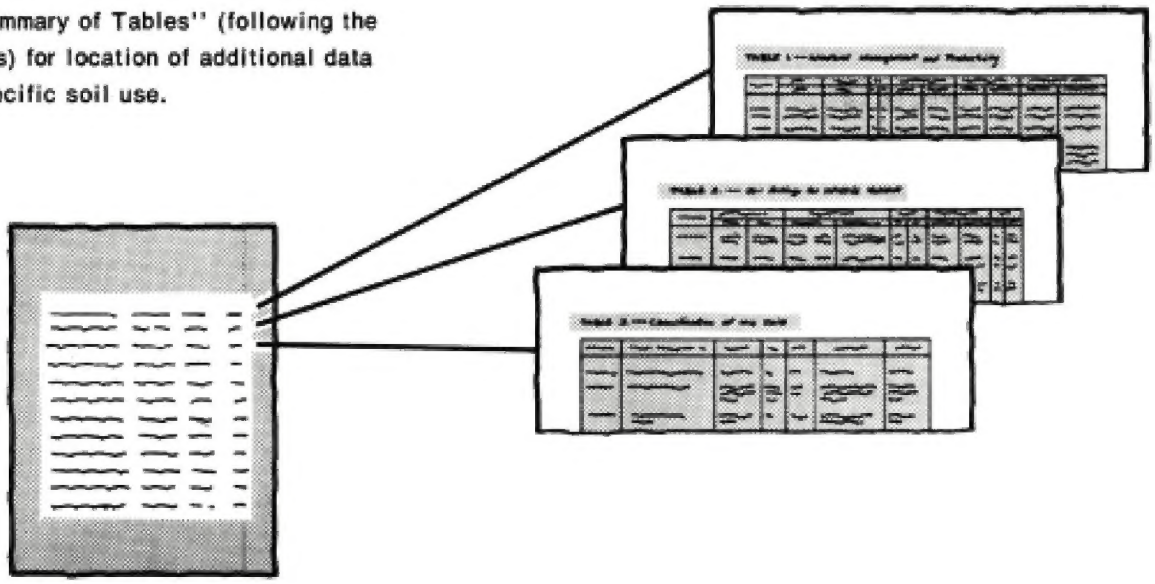


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Mills County Soil Conservation District. Funds appropriated by Mills County were used to defray part of the cost of the survey. Major fieldwork was performed in the period 1972-77. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Corn on nearly level soils on bottom land along the Missouri River. Very steep, loess-covered bluffs are in the background.

contents

soil series

Issued February 1982

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summary of tables

Preface

This soil survey contains information that can be used in land-planning programs in Mills County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

soil survey of
Mills County, Iowa

By John R. Nixon, Soil Conservation Service

Fieldwork by John R. Nixon, Mary A. Barger, Pat Pisarik,
Willie D. Bragg, Louis Boeckman, and Ken McWilliams,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Iowa Agriculture and Home Economics Experiment Station;
Cooperative Extension Service, Iowa State University;
and Department of Soil Conservation, State of Iowa

MILLS COUNTY is in the southwestern part of Iowa. It is in the second tier of counties north of the Iowa-Missouri state line and is bounded on the west by the Missouri River (fig. 1). It has an area of about 285,760 acres, or 446.5 square miles. Glenwood, the county seat, is about 150 miles southwest of Des Moines. It has a population of about 5,000.

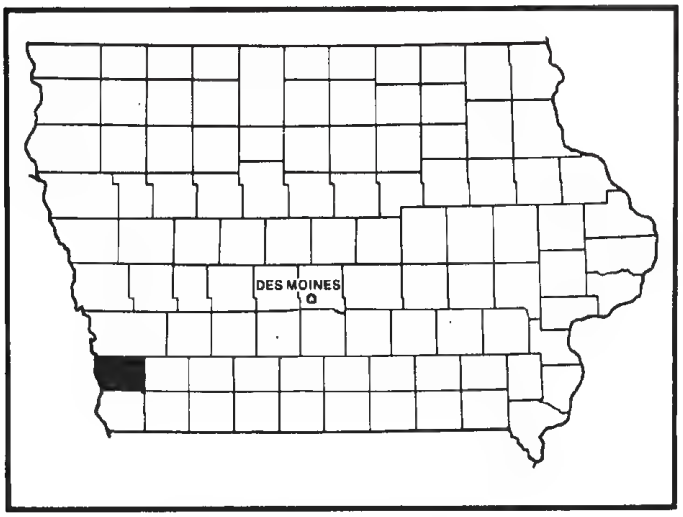

Figure 1.—Location of Mills County in Iowa.

The county was established in 1851. It was named after Frederick Mills, a young army officer who was killed during the Mexican War.

general nature of the county

The soils in the county formed in loess, glacial till, or alluvium under prairie grasses and, in small steep areas near streams, under trees. The low bottom land supported mainly marsh grasses and water tolerant trees. Most of the original stands of timber have been cut, except for those on the very steep slopes.

Farming and related businesses are the chief local sources of income. Most of the farmland is used for corn, soybeans, and hay. The feeding of livestock also is a major agriculture activity. In 1976, about 271,150 acres was farmland. The county had 850 farms, which averaged about 319 acres in size. In 1975, corn was planted on 101,700 acres, soybeans on 67,500 acres, oats on 8,400 acres, wheat on 4,150 acres, and sorghum on 200 acres. About 9,400 acres was used for hay and 32,446 acres for pasture.

The Mills County Soil Conservation District, the ninth conservation district established in Iowa, was organized in 1941.

This survey updates the soil survey of Mills County published in 1923 (*8*). It provides additional information and larger maps, which show the soils in greater detail.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Glenwood in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 25 degrees F, and the average daily minimum temperature is 16 degrees. The lowest temperature on record, which occurred at Glenwood on March 5, 1960, is minus 24 degrees. In summer the average temperature is 74 degrees, and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred at Glenwood on July 13, 1954, is 107 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 33 inches. Of this, 24 inches, or about 75 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.96 inches at Glenwood on June 21, 1967. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 32 inches. The greatest snow depth at any one time during the period of record was 18 inches. On an average of 19 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 13 miles per hour, in spring.

physiography, drainage, and relief

Mills County is in a part of Iowa covered by deep loess. It generally slopes southwest and west. The landscape is characterized mainly by flood plains and terraces along rivers, steep bluffs, and valley slopes and ridges in the uplands.

The county is drained by the Missouri River. The main tributaries in the county flow southwest into this river. The West Nishnabotna River and Silver Creek drain the central and northeastern parts of the county. Keg Creek and Waubonsie Creek drain the uplands in the western part.

On about 30 percent of the acreage in the county, the soils are nearly level and are on bottom land, and on about 4 percent they are steep or very steep. On the rest of the acreage, they are gently sloping to moderately steep. The highest point is about 1,350 feet above sea level. It is on the steep hills northwest of Glenwood. The lowest point is 950 feet above sea level. It is in the southwest corner of the county, near the Missouri River.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil associations

areas dominated by nearly level and gently sloping soils on bottom land along the Missouri River

These soils make up about 17 percent of the county. They formed in alluvium on bottom land along the Missouri River (fig. 2).

Most areas are used for corn or soybeans. These soils are well suited to cultivated crops. The principal management concern is reducing wetness. Levees protect most areas against floodwater. In many areas

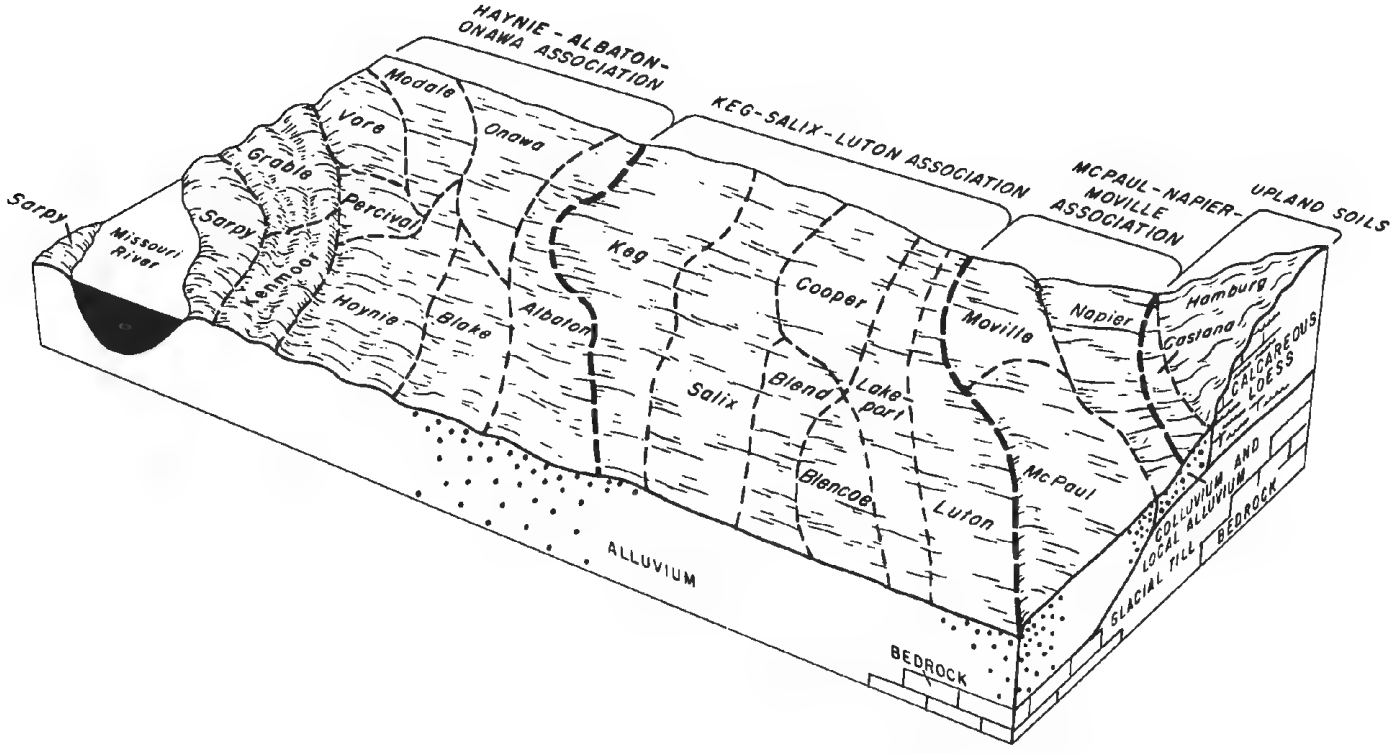

Figure 2.—Pattern of soils and parent material in associations 1, 2, and 3.

Figure 3.—Corn on the nearly level soils in the Haynie-Albaton-Onawa association on bottom land along the Missouri River.

well established surface drains remove excess water. In wet periods, however, they are not adequate. As a result, some crops are drowned out and replanting is needed. Also, fieldwork commonly is delayed. Subsurface tile drains do not work well in most areas.

1. Haynie-Albaton-Onawa association

Nearly level, well drained to poorly drained soils formed in alluvium on bottom land

This association is on flood plains characterized by swales and depressions. Some small sandy areas are hummocky. Crescent-shaped oxbow lakes and swales mark old river channels. The soils formed in alluvium deposited by the Missouri River.

This association makes up about 8 percent of the county. It is about 18 percent Haynie soils, 16 percent Albaton soils, 15 percent Onawa soils, and 51 percent soils of minor extent.

Haynie soils are well drained or moderately well drained and are in slightly elevated positions. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam and very fine sandy loam.

Albaton soils are poorly drained and are in swales and other low lying areas. Typically, the surface layer is very dark grayish brown, calcareous silty clay about 7 inches thick. The substratum to a depth of about 60 inches is olive gray and dark gray, mottled, calcareous silty clay.

Onawa soils are at intermediate elevations and are somewhat poorly drained or poorly drained. Typically, the surface layer is very dark gray silty clay about 7 inches thick. The upper part of the substratum is dark grayish brown, calcareous silty clay. The lower part to a depth of about 60 inches is grayish brown and light brownish gray, mottled, calcareous silt loam.

Minor in this association are Blake, Grable, Kenmoor, Sarpy, Vore, Percival, and Modale soils. The excessively drained Sarpy and well drained and somewhat excessively drained Grable soils are on the higher parts of the flood plain. The somewhat poorly drained Blake and Percival soils are on the low parts of the landscape. Vore, Kenmoor, and Modale soils are at intermediate elevations.

This association is used mainly for cultivated crops (fig. 3). Most areas have been cleared and drained. Wetness and poor tilth are problems. Dams constructed in upstream areas along the Missouri River help to

control flooding, but they do not control the floodwater from the tributaries that enter the Missouri River in downstream areas. Some of these areas are on the river side of levees. Plowing to a depth of 2 to 3 feet has improved areas where floodwater has deposited sand. The more sandy soils are subject to wind erosion.

2. Keg-Salix-Luton association

Nearly level, well drained, moderately well drained, poorly drained, and very poorly drained soils formed in alluvium on bottom land

This association generally is on bottom land characterized by small changes in elevation and some swales and depressions. The soils formed in alluvium deposited by the Missouri River.

This association makes up about 5 percent of the county. It is about 22 percent Keg soils, 20 percent Salix soils, 14 percent Luton soils, and 44 percent soils of minor extent.

Keg soils are well drained or moderately well drained and are in slightly elevated positions. Typically, the surface layer is black silt loam about 6 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is dark grayish brown, friable silt loam about 23 inches thick. It is mottled and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silt loam.

Salix soils are moderately well drained and are at intermediate elevations. Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown, friable silty clay loam about 6 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The substratum to a depth of about 60 inches is brown, mottled, calcareous coarse silt loam.

Luton soils are poorly drained or very poorly drained and are at the lowest elevations. Typically, the surface layer is black silty clay about 14 inches thick. The subsurface layer is very dark gray, firm silty clay about 11 inches thick. The subsoil is very firm, calcareous silty clay about 19 inches thick. The upper part is very dark gray, and the lower part is dark gray and mottled. The substratum to a depth of about 60 inches is dark gray, mottled, calcareous silty clay.

Minor in this association are Lakeport, Cooper, Blencoe, and Blend soils. The somewhat poorly drained Lakeport and Cooper soils and the somewhat poorly drained or poorly drained Blencoe soils are at the intermediate elevations on the landscape. The poorly drained Blend soils are on the low parts of the landscape.

This association is used mainly for cultivated crops. The major management concern is reducing wetness. A well established system of drainage ditches parallels the roads and drains excess water into the Missouri River. The larger ditches also receive water from the tributaries. Surface drains generally remove excess water from fields and into drainage networks. In wet periods, however, they are not adequate. As a result, some crops are drowned out and replanting is needed. Also, fieldwork commonly is delayed. In some areas land leveling is needed to improve drainage. If the spring is dry and winds are strong, wind erosion is a hazard. Maintaining fertility is important because the soils are intensively cropped.

3. McPaul-Napier-Moville association

Nearly level and gently sloping, well drained to somewhat poorly drained soils formed in alluvium on bottom land and foot slopes and in upland drainageways

This association generally is on bottom land along the Missouri River, in small drainageways, and on alluvial fans and foot slopes. The soils formed in alluvium deposited by upland streams.

This association makes up about 4 percent of the county. It is about 40 percent McPaul soils, 25 percent Napier soils, 10 percent Moville soils, and 25 percent soils of minor extent.

McPaul soils are well drained or moderately well drained and are nearly level. They are in areas of recent deposition in settling basins and near streams that flow from the uplands. Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and grayish brown, calcareous, stratified silt loam.

Napier soils are well drained and are gently sloping. They are on alluvial fans and the foot slopes of adjacent uplands. Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam about 23 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown and brown silt loam.

Moville soils are somewhat poorly drained and are nearly level. They are at the lowest elevations. Typically, the surface layer is very dark grayish brown, calcareous silt loam about 7 inches thick. The substratum is dark grayish brown, gray, grayish brown, and very dark gray, very friable, stratified silt loam about 18 inches thick. Below this to a depth of about 60 inches is a buried layer of black, very dark gray, olive gray, and dark gray silty clay.

Minor in this association are Kennebec, Nodaway, Colo, Rawles, and Monona soils. The moderately well drained Kennebec and Nodaway soils are near stream channels. The poorly drained Colo soils are some distance from the stream channels, on the low parts of the landscape. The moderately well drained Rawles soils are in the intermediate positions between the Colo and

Nodaway soils. The well drained Monona soils are on high benches or terraces near the sides of valleys.

Most areas are intensively cropped to corn and soybeans. These soils generally are well suited to cultivated crops. Most of the crops are sold for cash. Few livestock are kept on the farms. Many streams from the uplands cross this association before draining into the Missouri River. Surface drains generally remove excess water from fields and into drainage networks. Maintaining fertility is a major management concern.

areas dominated by moderately sloping to very steep soils on uplands

These soils make up about 4 percent of the county. They formed in calcareous loess on uplands.

The moderately sloping soils are moderately well suited to cultivated crops. The steep and very steep soils are poorly suited to cultivated crops and are better suited to pasture. In many areas only the ridgetops are suitable for cultivation. The principal management concerns are controlling erosion and improving fertility. Returning crop residue to the soil or regularly adding other organic material to the plow layer improves fertility and increases the rate of water infiltration.

4. Ida-Hamburg association

Moderately sloping to very steep, well drained and somewhat excessively drained soils formed in loess on uplands

This association generally is on uplands adjacent to bottom land along the Missouri River. It makes up about 4 percent of the county. It is about 45 percent Ida soils, 20 percent Hamburg soils, and 35 percent soils of minor extent.

Ida soils are well drained and are moderately sloping to steep. They are on narrow ridgetops and on side slopes. Typically, the surface layer is dark brown, calcareous silt loam about 5 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, mottled, calcareous silt loam.

Hamburg soils are somewhat excessively drained and are very steep. They are on side slopes characterized by catsteps (fig. 4). Typically, the surface layer is dark brown, calcareous coarse silt loam about 4 inches thick. Below this is a transitional layer of brown, very friable, calcareous coarse silt loam about 6 inches thick. The substratum to a depth of about 60 inches is brown, calcareous coarse silt loam.

Figure 4.—Catsteps in an area of the very steep Hamburg soils in the Ida-Hamburg association. Gently sloping Napier soils are in the valley.

Figure 5.—Moderately sloping Monona soils on ridges and steep Ida soils on side slopes in an area of the Monona-Ida association.

Minor in this association are the well drained Monona, Napier, Castana, and Steinauer soils and Gullied land. Monona soils are on ridgetops and side slopes. Napier soils are on foot slopes and along small drainageways. Castana soils are downslope from the Hamburg soils. Steinauer soils are on side slopes. Gullied land is in deep, narrow drainageways adjacent to the Napier soils.

Livestock farming is more common on this association than other kinds of farming. Many areas, especially the steeper ones, are pastured. Some ridgetops and side slopes and some small areas along drainageways are used for cultivated crops or for hay. Runoff and erosion are problems.

areas dominated by gently sloping to steep soils on uplands

These soils make up about 18 percent of the county. They formed in loess on uplands.

The gently sloping soils are well suited to cultivated crops. The moderately steep and steep soils are poorly suited to cultivated crops and are better suited to pasture. The principal management concerns are controlling erosion, improving fertility, and maintaining tilth. The less sloping soils are well suited to terracing, contour farming, and stripcropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

5. Monona-Ida association

Gently sloping to steep, well drained soils formed in loess on uplands

This association is in the uplands. The soils on ridgetops are gently sloping and moderately sloping and those on the side slopes strongly sloping to steep (fig. 5).

This association makes up about 18 percent of the county. It is about 40 percent Monona soils, 30 percent Ida soils, and 30 percent soils of minor extent (fig. 6).

Monona soils are on ridgetops and side slopes and are gently sloping to steep. Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Ida soils are on narrow ridgetops and on side slopes and are strongly sloping to steep. Typically, the surface

layer is dark brown, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, mottled, calcareous silt loam.

Minor in this association are Napier, Dow, Malvern, Adair, and Shelby soils. The well drained Napier soils are along small drainageways. The well drained Dow soils and the moderately well drained or somewhat poorly drained Malvern and Adair soils are on side slopes. The moderately well drained or well drained Shelby soils are downslope from the Malvern and Adair soils.

This association is used for cultivated crops or for pasture and hay. In areas where the soils are not too steep, corn and soybeans are grown in rotation with small grain and hay. Much of the grain and hay is fed to livestock raised for marketing. Controlling runoff and erosion and maintaining fertility are management concerns. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

areas dominated by nearly level to strongly sloping soils on uplands

These soils make up about 51 percent of the county. They formed in loess on uplands.

The nearly level to gently sloping soils are well suited to cultivated crops. The moderately sloping to strongly sloping soils, however, are only moderately well suited. The principal management concerns are controlling erosion, improving fertility, and maintaining tilth. These soils are well suited to terracing, contour farming, and stripcropping. In some wet areas along drainageways, a combination of terracing and tiling is needed. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

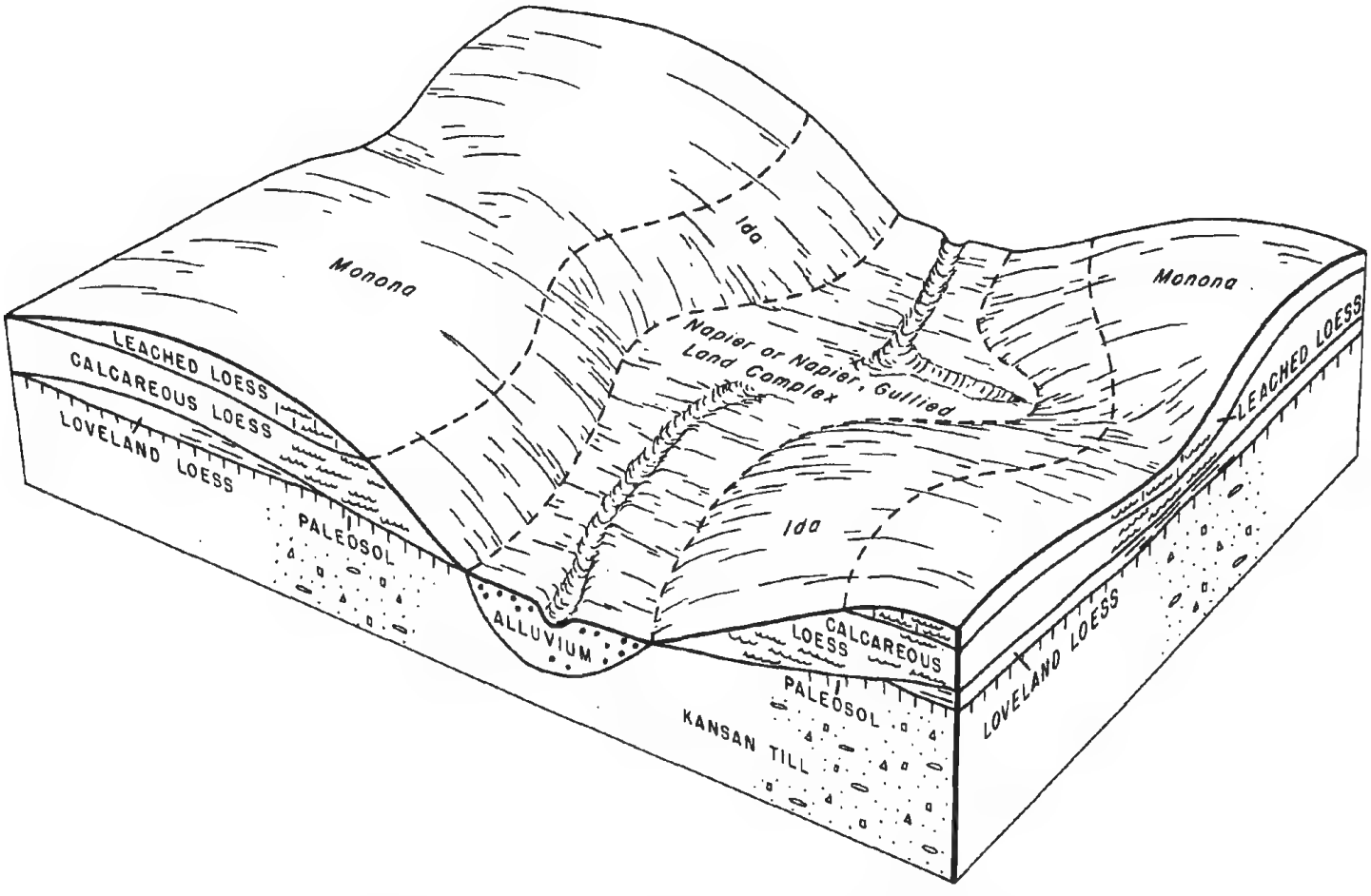

Figure 6.—Pattern of soils and parent material in the Monona-Ida association.

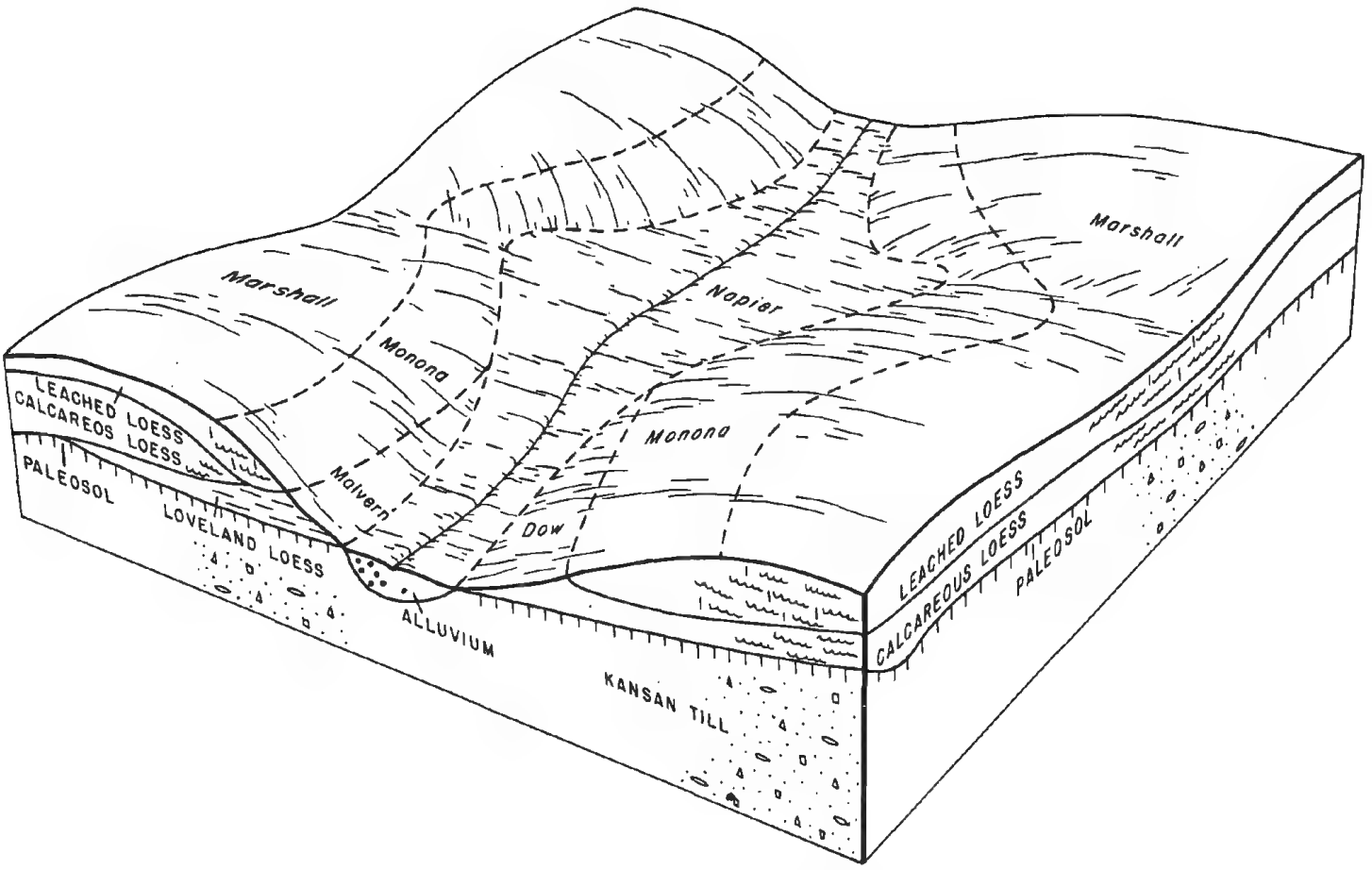

Figure 7.—Pattern of soils and parent material in the Monona-Marshall association.

6. Monona-Marshall association

Nearly level to strongly sloping, well drained soils formed in loess on uplands

This association is on uplands. The soils on ridgetops are nearly level to gently sloping and those on side slopes moderately sloping to strongly sloping.

This association makes up about 16 percent of the county. It is about 44 percent Monona soils, 25 percent Marshall soils, and 31 percent soils of minor extent (fig. 7).

Monona soils are on narrow ridgetops and on side slopes and are gently sloping to strongly sloping. Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Marshall soils are gently sloping on ridgetops and moderately sloping on side slopes. Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown, grayish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam.

Minor in this association are Malvern, Napier, Kennebec, Ida, Dow, and Shelby soils. The well drained Napier soils and the moderately well drained Kennebec soils are along drainageways. The well drained Ida and Dow soils and the moderately well drained or somewhat poorly drained Malvern soils are on side slopes. The moderately well drained and well drained Shelby soils are on the lower side slopes.

This association is used mainly for cultivated crops. The principal management concerns are controlling erosion, improving fertility, and maintaining tilth. Most of the soils are well suited to terracing. In some areas a

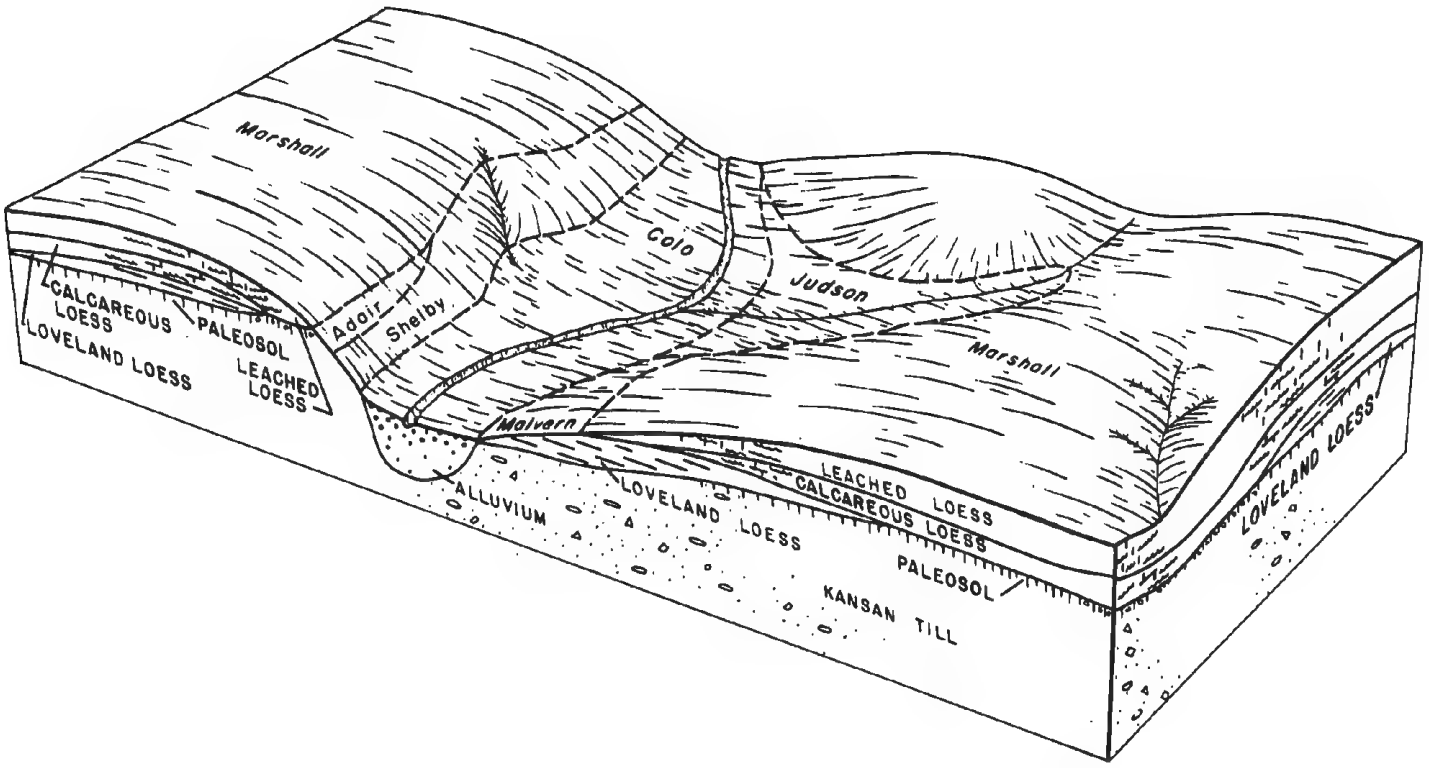

Figure 8.—Pattern of soils and parent material in the Marshall association.

combination of terracing and tiling is needed. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

7. Marshall association

Nearly level to strongly sloping, well drained soils formed in loess on uplands

This association is in the uplands. The soils on ridgetops are nearly level to gently sloping and those on side slopes gently sloping to strongly sloping.

This association makes up about 31 percent of the county. It is about 65 percent Marshall soils and 35 percent soils of minor extent (fig. 8).

Marshall soils are on ridgetops and side slopes. Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown, grayish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam.

Minor in this association are Adair, Colo, Judson, Kennebec, Dow, Malvern, Strahan, and Shelby soils. The well drained Dow and Strahan soils, the moderately well drained or well drained Shelby soils, and the moderately well drained or somewhat poorly drained Adair and Malvern soils are on side slopes. The well drained or moderately well drained Judson soils are on foot slopes and fans. The poorly drained Colo soils and the moderately well drained Kennebec soils are along drainageways.

This association is used mainly for cultivated crops. Some areas are used for hay and pasture. Fattening beef cattle is the most common livestock enterprise. Controlling sheet and gully erosion is a major management concern. Maintaining fertility is also important. Most of the soils are well suited to terracing, contour farming, and stripcropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

8. Marshall-Minden association

Nearly level to moderately sloping, well drained and somewhat poorly drained soils formed in loess on benches

This association generally is on high benches or terraces in the valley along the West Nishnabotna River (fig. 9). The soils formed in loess. Most are nearly level, but some are gently sloping or moderately sloping.

This association makes up about 4 percent of the county. It is about 55 percent Marshall soils, 20 percent Minden soils, and 25 percent soils of minor extent.

Marshall soils are well drained and are nearly level to moderately sloping. They are on benches. Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown, grayish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In places the loess is underlain by sandy alluvial sediments.

Minden soils are somewhat poorly drained and are nearly level. They are on high benches along streams. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 13 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, friable silty clay loam about 22 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silt loam.

Minor in this association are Kennebec, Judson, Corley, Nevin, and Bremer soils. The moderately well drained Kennebec soils and the well drained or moderately well drained Judson soils are near the sides of valleys. The poorly drained Corley soils are on the low parts of high benches. The somewhat poorly drained Nevin soils and the poorly drained Bremer soils are on low benches and are downslope from the Marshall and Minden soils.

Most areas are used for corn and soybeans. These soils generally are well suited to cultivated crops. Maintaining fertility and improving drainage are the major management concerns. Tile drains generally are not needed in the somewhat poorly drained Minden soils but are needed in the more poorly drained soils of minor extent. The sloping soils are subject to erosion. In some areas terraces or a combination of terraces and tile drainage is needed.

areas dominated by nearly level soils on bottom land

These soils make up about 10 percent of the county. They formed in alluvium on bottom land.

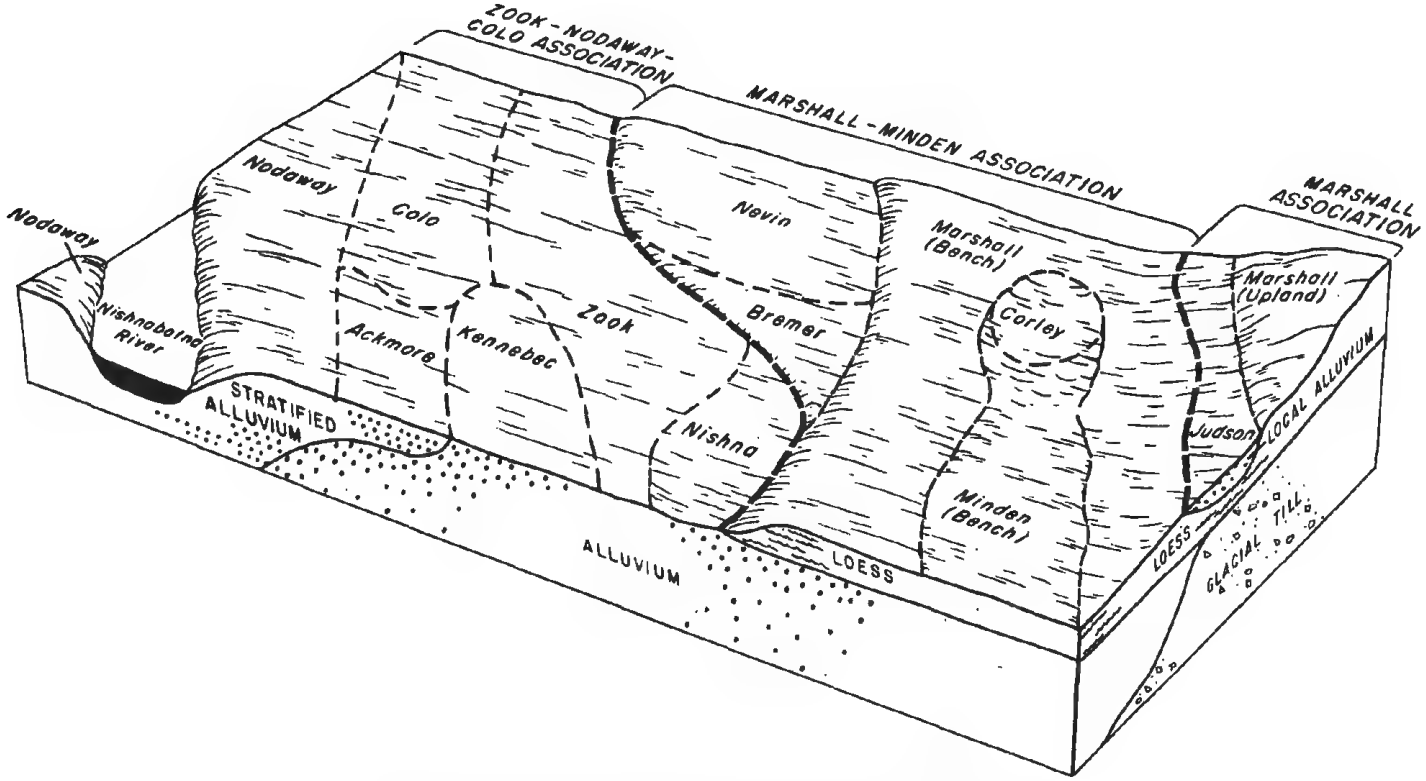

Figure 9.—Pattern of soils and parent material in associations 8 and 9.

Most areas are used for corn. These soils are well suited to cultivated crops. The principal management concerns are wetness and flooding. If drainage outlets are available, subsurface tile can be installed in the Colo and Zook soils to improve drainage. Zook soils remain wet for longer periods in spring than Colo and Nodaway soils. As a result, tile lines should be more closely spaced and, if feasible, a surface drainage system should be installed.

9. Zook-Nodaway-Colo association

Nearly level, poorly drained and moderately well drained soils formed in alluvium on bottom land

This association is on the flood plains along the West Nishnabotna River and its tributaries. It makes up about 10 percent of the county. It is about 30 percent Zook soils, 25 percent Nodaway soils, 10 percent Colo soils, and 35 percent soils of minor extent (fig. 9).

Zook soils are poorly drained and generally are some distance from the stream channel. Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is about 21 inches thick. The upper part is black, friable silty clay loam, and the lower part is black, firm silty clay. The subsoil is very dark gray, very firm silty clay about 24 inches thick. The substratum to a depth of about 65 inches is dark gray, mottled silty clay.

Nodaway soils are moderately well drained and generally are adjacent to the stream channel. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, grayish brown, and very dark grayish brown, stratified silt loam.

Colo soils are poorly drained and generally are some distance from the stream channel. Typically, the surface layer is black silty clay loam about 17 inches thick. The subsurface layer is black, firm silty clay loam about 14 inches thick. Below this is a transitional layer of very dark gray, firm silty clay loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown silty clay loam.

Minor in this association are Bremer, Kennebec, Nevin, Nishna, Ackmore, and Calco soils. The poorly drained Nishna soils and the poorly drained or very poorly drained Calco soils are on the lower parts of the landscape some distance from the stream channels. The poorly drained Bremer soils and the somewhat poorly drained Nevin soils are on low benches. The moderately well drained Kennebec soils and the somewhat poorly drained or poorly drained Ackmore soils are close to the stream channels.

Most of this association is intensively row cropped. Corn and soybeans are the major crops. The main management needs are measures that maintain fertility, reduce wetness, and control flooding. A drainage system is needed at the lower elevations. In many areas, however, installing surface drains and subsurface tile is difficult because adequate outlets are not available. Flooding occurs along the West Nishnabotna River and its tributaries.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Monona silt loam, 2 to 5 percent slopes, is one of several phases in the Monona series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Orthents, loamy, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

1C—Ida silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow, rounded ridgetops and the upper parts of side slopes in the uplands. Areas range from 5 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is dark brown, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, very friable, calcareous silt loam. It is mottled in the lower part. In some places the surface layer is darker and is more than 7 inches thick, and in other places the upper 2 feet is noncalcareous because of leaching.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.0 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to

prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

1C3—Ida silt loam, 5 to 9 percent slopes, severely eroded. This moderately sloping, well drained soil is on narrow, rounded ridgetops and the upper parts of side slopes in the uplands. Areas range from 5 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 7 inches thick. Plowing has mixed some dark yellowish brown substratum material with the surface layer. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, very friable, calcareous silt loam. It is mottled in the lower part. In many places calcium carbonate concretions are on the surface.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium. The surface layer is subject to crusting after rains because of the low organic matter content.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

1D—Ida silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland ridges and side slopes. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, mottled, very friable, calcareous silt loam. In places, the surface layer is darker and is more than 7 inches thick and the upper 2 feet is noncalcareous because of leaching. In a few places the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.0 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

1D3—Ida silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland ridges and side slopes. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 7 inches thick. Plowing has mixed some dark yellowish brown substratum material with the surface layer. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface. In some areas the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline

throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium. The surface layer is subject to crusting after rains because of the low organic matter content.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

1E—Ida silt loam, 14 to 20 percent slopes. This moderately steep, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, mottled, very friable, calcareous silt loam. In places, the surface layer is darker and is more than 7 inches thick and the upper 2 feet is noncalcareous because of leaching. In a few places the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for pasture or woodland (fig. 10). This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and

Figure 10.—An area of Ida silt loam, 14 to 20 percent slopes, used for pasture and woodland.

pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

1E3—Ida silt loam, 14 to 20 percent slopes, severely eroded. This moderately steep, well drained soil is on upland side slopes. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 6 inches thick. Plowing has mixed some dark yellowish brown substratum material with the surface layer. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface. In some areas the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium. The surface layer is subject to crusting after rains because of the low organic matter content.

Most areas are pastured. Some are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

1F—Ida silt loam, 20 to 30 percent slopes. This steep, well drained soil is on upland side slopes. Areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown, calcareous silt loam about 5 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, very friable, calcareous silt loam. It is mottled in the lower part. In some areas, the surface layer is darker and is more than 5 inches thick and the upper 1 foot is noncalcareous because of leaching. In other areas the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to corn, soybeans, and small grain. It is better suited to native grasses for hay and pasture. If cultivated crops are grown, erosion is a severe hazard.

A cover of pasture plants or hay helps to prevent excessive soil loss. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is VIe.

1F3—Ida silt loam, 20 to 30 percent slopes, severely eroded. This steep, well drained soil is on upland side slopes. Areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 5 inches thick. In plowed areas it has been mixed with some dark yellowish brown substratum material. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface. In some areas the substratum is brownish gray and grayish brown.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low

supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for pasture. This soil generally is unsuited to corn, soybeans, and small grain because the slopes are steep and because further erosion is a hazard. It is better suited to native pasture grasses.

A cover of pasture plants is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is VIe.

2G—Hamburg-Ida silt loams, 30 to 75 percent slopes. These very steep, somewhat excessively drained and well drained soils are on upland side slopes. Catsteps are common in areas of the Hamburg soil. Areas range from 5 to 150 acres in size and are irregularly shaped. They are about 60 percent Hamburg soil and 30 percent Ida soil. The two soils occur as areas so intermingled that mapping them separately is impractical.

Typically, the Hamburg soil has a surface layer of dark brown, calcareous coarse silt loam about 4 inches thick. Below this is a transitional layer of brown, very friable, calcareous coarse silt loam about 6 inches thick. The substratum to a depth of about 60 inches is brown, calcareous coarse silt loam.

Typically, the Ida soil has a surface layer of dark brown, calcareous silt loam about 5 inches thick. The substratum to a depth of about 60 inches is brown, dark yellowish brown, and yellowish brown, calcareous silt loam. It is mottled in the lower part. In some places the surface layer is less than 5 inches thick, and in other places the upper 12 inches is noncalcareous.

Permeability is moderate in the Hamburg and Ida soils, and runoff is very rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. The soils typically are mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for native pasture grasses or woodland. The very steep slope restricts the use of farm machinery. These soils are not suited to cultivated crops or to grasses and legumes for hay. They are suited, however, to native pasture grasses and upland wildlife habitat. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. Species that can grow well in a calcareous soil should be selected for planting.

The capability subclass is VIIe.

3E—Castana silt loam, 9 to 20 percent slopes. This strongly sloping and moderately steep, well drained soil is on foot slopes. Areas range from 5 to 35 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is very dark grayish brown, calcareous silt loam about 5 inches thick. Below this is a transitional layer of brown, very friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some places the surface soil is less than 7 inches thick. In other places it contains more organic matter and is not calcareous.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for row crops. Some large areas are pastured. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained or moderately well drained soil is on foot slopes and alluvial fans in upland drainageways. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 28 inches thick. It is black in the upper part, very dark brown in the next part, and very dark grayish brown in the lower part. The subsoil to a depth of about 60 inches is dark brown and brown, mottled, friable silty clay loam.

Included with this soil in mapping are some small areas of the nearly level, poorly drained Colo soils. These soils dry out more slowly after rains than the Judson soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Judson soil, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The soil typically is slightly acid or neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIe.

8C—Judson silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained or moderately well drained soil is on foot slopes and alluvial fans in upland drainageways. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 28 inches thick. The upper part is black, the next part is very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of about 60 inches is dark brown and brown, mottled, friable silty clay loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The soil typically is slightly acid or neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIe.

9—Marshall silty clay loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, stable upland ridgetops. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown, grayish brown, and yellowish brown and is mottled. The substratum to a depth of about 64 inches is yellowish brown and grayish brown, mottled silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil and neutral in the lower part of the subsoil and in the substratum. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

The capability class is I.

9B—Marshall silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad upland ridgetops. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 64 inches is mottled yellowish brown and grayish brown silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil and neutral in the lower part of the subsoil and in the substratum. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops.

Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

9C—Marshall silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown silt loam. In places gray mottles are within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil and neutral in the lower part of the subsoil and in the substratum. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

9C2—Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is friable silty clay loam about 30 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown silt loam. In some places gray mottles are within a depth of 24 inches, and in other places the surface layer is more than 8 inches thick.

Included with this soil in mapping are small areas of the severely eroded Marshall soils. These moderately sloping soils are on narrow ridgetops. They make up less than 10 percent of the unit.

Permeability is moderate in the Marshall soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. Reaction typically is slightly acid in the surface layer and the upper part of the subsoil and neutral in the lower part of the subsoil and in the substratum. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

9D—Marshall silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 4 inches thick. The subsoil is friable silty clay loam about 24 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled yellowish brown and

grayish brown silt loam. In places gray mottles are within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The soil typically is slightly acid or neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

9D2—Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is friable silty clay loam about 24 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown silt loam. In some places gray mottles are within a depth of 24 inches, and in other places the surface layer is more than 8 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The soil typically is slightly acid or neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

9D3—Marshall silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown and brown silty clay loam about 7 inches thick. Plowing has mixed much of the subsoil with the surface layer. The subsoil is friable silty clay loam about 24 inches thick. The upper part is brown, and the lower part is brown, grayish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In some places gray mottles are within a depth of 24 inches, and in other places the surface layer is more than 7 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. The soil typically is slightly acid or neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

10B—Monona silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad upland

ridgetops. Areas range from 5 to 50 acres in size and are long and wide.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 7 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface soil and subsoil are silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

10C—Monona silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridgetops and long side slopes in the uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 5 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface soil and subsoil are silty clay loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

10C2—Monona silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 8 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface layer is more than 8 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

10D—Monona silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 5 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

10D2—Monona silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 8 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface layer is more than 8 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. This soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops (fig. 11). This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained.

Figure 11.—Corn in an area of Monona silt loam, 9 to 14 percent slopes, moderately eroded. The hay is on the gently sloping Napier soils.

Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

10D3—Monona silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is dark brown and brown silt loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places it is calcareous within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. Reaction typically is neutral in the surface layer and subsoil. The substratum generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

10E—Monona silt loam, 14 to 20 percent slopes. This moderately steep, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 5 inches thick. The subsoil is brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. Some large areas are pastured. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

10E2—Monona silt loam, 14 to 20 percent slopes, moderately eroded. This moderately steep, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 6 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface layer is more than 6 inches thick.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. Reaction typically is neutral in the surface layer and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow

crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

10E3—Monona silt loam, 14 to 20 percent slopes, severely eroded. This moderately steep, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is dark brown and brown silt loam about 6 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places it is calcareous within a depth of 24 inches.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is less than 0.5 percent. Reaction typically is neutral in the surface layer and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

10F2—Monona silt loam, 20 to 30 percent slopes, moderately eroded. This steep, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface layer is more than 7 inches thick.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. Reaction typically is neutral in the surface layer and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are pastured. This soil generally is unsuited to corn, soybeans, and small grain because the slopes are steep and because further erosion is a severe hazard. It is moderately suited to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is VIe.

11B—Colo-Judson silty clay loams, 2 to 5 percent slopes. These gently sloping soils are along drainageways. The poorly drained Colo soil is on the lower parts of the landscape and is subject to flooding unless it is protected. The well drained or moderately well drained Judson soil is on the higher parts of the landscape. Areas range from 5 to 75 acres in size. They are about 55 percent Colo soil and 40 percent Judson soil. The two soils occur as areas so small and so narrow that mapping them separately is impractical.

Typically, the surface layer of the Colo soil is black silty clay loam about 17 inches thick. The subsurface layer is black silty clay loam about 14 inches thick. Below this is a transitional layer of very dark gray, firm silty clay loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown silty clay loam. In some places it is silty clay. In other places about 12 inches of recently deposited silt loam overlies the surface layer.

Typically, the surface layer of the Judson soil is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown silty clay loam about 28 inches thick. The subsoil to a depth of about 60 inches is dark brown and brown, mottled, friable silty clay loam. In places the soil is silt loam throughout and is dark to a greater depth.

Permeability is moderate in the Colo and Judson soils, and runoff is slow. Available water capacity is high. The

Colo soil has a seasonal high water table. The content of organic matter is about 5 to 7 percent in the surface layer of the Colo soil and 3.5 to 4.5 percent in the surface layer of the Judson soil. The surface layer of both soils typically is slightly acid. The supply of available phosphorus and potassium generally is medium in the substratum of the Colo soil and low in the subsoil of the Judson soil.

Most areas are used for row crops. These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas a drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well in the Colo soil if they are properly installed and if an adequate outlet is available. Tilth typically is fair in the surface layer of the Colo soil and good in that of the Judson soil. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soils are wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If these soils are used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

12B—Napier silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on foot slopes and in upland drainageways. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 23 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown and brown, friable silt loam. In some places the surface layer contains less organic matter. In other places the soil is moderately well drained.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIe.

12C—Napier silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on foot slopes and in upland drainageways. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam about 23 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown and brown, friable silt loam. In places the soil is steeper, contains less organic matter, and is calcareous.

Included with this soil in mapping are some small areas of Monona soils. These soils are steeper than the Napier soil and contain less organic matter. They make up less than 10 percent of the unit.

Permeability is moderate in the Napier soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIe.

22C2—Dow silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes and narrow ridgetops in the uplands. Areas range from 5 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is brown and dark brown, calcareous silt loam about 7 inches thick. Plowing has mixed some of the substratum with the surface layer. The substratum to a depth of about 60 inches is light brownish gray, mottled, calcareous silt loam. In places, the soil is noncalcareous and the substratum is brown and dark yellowish brown.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic

matter in the surface layer is about 1 to 2 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

22D2—Dow silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 30 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is brown and dark brown, friable, calcareous silt loam about 7 inches thick. Plowing has mixed some of the yellowish brown substratum with the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, calcareous silt loam. In places, the soil is noncalcareous and the substratum is brown and dark yellowish brown.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Overgrazing causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

24D2—Shelby clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or well drained soil is on convex side slopes in the uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray clay loam about 7 inches thick. The subsurface layer is very dark grayish brown clay loam about 7 inches thick. Plowing has mixed some of the subsurface layer with the surface layer. The subsoil is clay loam about 28 inches thick. The upper part is dark brown and friable, the next part is dark yellowish brown and friable, and the lower part is brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled grayish brown and dark yellowish brown clay loam. Pebbles are in the subsoil and substratum. In some areas the surface layer is more than 7 inches thick. In other areas it is less than 7 inches thick because of erosion. In these areas stones and pebbles are on the surface. In places the soil contains more clay and has redder mottles.

Included with this soil in mapping are some small areas of the well drained, calcareous Steinauer soils. These soils are in positions on the landscape similar to those of the Shelby soil. They make up less than 10 percent of the unit.

Permeability is moderately slow in the Shelby soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 1 to 2 percent. Reaction typically is medium acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a high supply of available potassium.

Some areas are used for row crops. Some large areas are pastured. In most areas this soil is managed along with adjacent soils. It is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. The stones on the surface in some areas can result in damage to farm equipment unless they are removed. Good tilth generally

can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained or well drained soil is on convex side slopes in the uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is clay loam about 28 inches thick. The upper part is dark brown and friable, the next part is dark yellowish brown and friable, and the lower part is brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown and dark yellowish brown, mottled clay loam. Stones and pebbles are in the subsoil and substratum. In some areas the surface layer is more than 7 inches thick and is very dark gray. In other areas it is less than 7 inches thick because of severe erosion. In these areas stones and pebbles are on the surface. In places the soil contains more clay and has redder mottles.

Included with this soil in mapping are some small areas of the well drained, calcareous Steinauer soils. These soils are in positions on the landscape similar to those of the Shelby soil. They make up less than 10 percent of the unit.

Permeability is moderately slow in the Shelby soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. Reaction typically is medium acid or strongly acid in the surface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a high supply of available potassium.

Most areas are used for pasture. This soil is poorly suited to corn, soybeans, and small grain, mainly because it is subject to erosion. It is moderately suited to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

33D—Steinauer clay loam, 11 to 18 percent slopes. This moderately steep, well drained soil is on convex side slopes in the uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, calcareous clay loam about 7 inches thick. Below this is a transitional layer of yellowish brown, friable, calcareous clay loam about 6 inches thick. In cultivated areas plowing has mixed part of the substratum with the surface layer. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. It contains pebbles. In some areas the surface layer is only about 3 inches thick because of severe erosion. In these areas stones and pebbles are on the surface.

Included with this soil in mapping are small areas of the moderately well drained or well drained Shelby soils. These soils are in positions on the landscape similar to those of the Steinauer soil. They are not calcareous. They make up less than 10 percent of the unit.

Permeability is moderately slow in the Steinauer soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1 percent. Reaction typically is moderately alkaline in the surface layer and the upper part of the substratum. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for pasture. This soil is poorly suited to corn, soybeans, and small grain, mainly because it is subject to erosion. It is moderately suited to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

36—Salix silty clay loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is at the intermediate elevations on bottom land. It is subject to rare flooding. Areas range from 3 to 125 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown silty clay loam about 6 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The substratum to a depth of about 60 inches is brown, mottled, calcareous coarse silt loam. In some places 6 to 18 inches of recently deposited light colored silt loam overlies the surface

layer. In other places the surface soil and the subsoil are silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained or poorly drained Blencoe soils. These soils are at the lower elevations and are subject to ponding after rains. They make up less than 10 percent of the unit.

The Salix soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

43—Bremer silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low alluvial terraces on bottom land. It is occasionally flooded. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam about 10 inches thick. The subsoil is firm silty clay loam about 37 inches thick. The upper part is very dark gray, and the lower part is dark gray and dark grayish brown and is mottled. The substratum to a depth of about 60 inches is gray, mottled silty clay loam. In some areas the dark surface soil extends to a depth of 36 inches or more. In other areas the soil is somewhat poorly drained.

Included with this soil in mapping are some small areas of Zook soils. These soils contain more clay in the subsoil than the Bremer soil. Also, they are lower on the landscape and dry out more slowly. They make up less than 10 percent of the unit.

The Bremer soil is moderately slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Surface drains are needed in some areas. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

44—Blencoe silty clay, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is at the lower elevations on bottom land. It is subject to rare flooding. Areas are irregularly shaped. They generally range from 5 to 50 acres in size, but one area is 250 acres.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is black silty clay about 7 inches thick. The subsoil is about 18 inches thick. The upper part is very dark grayish brown, firm silty clay; the next part is dark grayish brown, mottled, friable silty clay loam; and the lower part is dark grayish brown, mottled, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous coarse silt loam. In places the surface soil and subsoil are silty clay.

Included with this soil in mapping are small areas of the moderately well drained Salix soils. These soils are slightly higher on the landscape than the Blencoe soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Blencoe soil is slowly permeable in the upper part and moderately permeable in the lower part. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 5 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to

prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

46—Keg silt loam, 0 to 2 percent slopes. This nearly level, well drained or moderately well drained soil is at the slightly higher elevations on bottom land. It is subject to rare flooding. Areas are long and irregularly shaped. They generally range from 5 to 200 acres in size, but some are as large as 400 acres.

Typically, the surface layer is black silt loam about 6 inches thick. The subsurface layer is very dark gray and very dark grayish brown silt loam about 5 inches thick. The subsoil is dark grayish brown, friable silt loam about 23 inches thick. It is mottled and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silt loam that has thin strata of silty clay loam. In places the surface layer is silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. Reaction typically is slightly acid or neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on bottom land. It is frequently flooded for brief to long periods unless it is protected. Areas range from 5 to 250 acres in size and are wide and irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is about 21 inches thick. The upper part is black silty clay loam, and the lower part is black silty clay. The subsoil is very dark gray, very firm silty clay about 24 inches thick. The substratum to a depth of about 65 inches is dark gray, mottled, firm silty clay. In some places the surface layer is overlain by about 12 inches of recently deposited silt loam. In other places it is silty clay. In some areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Bremer soils. These soils are slightly higher on the landscape than the Zook soil. They make up less than 10 percent of the unit.

The Zook soil is slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. Reaction typically is slightly acid in the surface layer and neutral in the subsurface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. If adequately drained, this soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. Surface drains are needed to remove surface water in some areas. Tilth generally is fair in the surface layer. Returning crop residue to the soil and deferring tillage when the soil is wet help to maintain tilth.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The capability subclass is IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on bottom land. It is frequently flooded for brief to long periods unless it is protected. Areas range from 5 to 75 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 13 inches thick. It is dark grayish brown or grayish brown silt loam. Below this is about 20 inches of black silty clay loam and 15 inches of black silty clay. The subsoil is very dark gray, firm silty clay about 12 inches thick. The substratum to a depth of 67 inches is dark gray, mottled silty clay. In some places the dark underlying layers are calcareous. In other places the subsoil contains less clay.

Included with this soil in mapping are some small areas of the somewhat poorly drained Ackmore soils. These soils are slightly higher on the landscape than the Zook soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Zook soil is slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. Reaction typically is neutral or slightly acid in the surface layer and the upper part of the underlying layers. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. If adequately drained, this soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. Surface drains are needed to remove surface water in some areas. Good tilth generally can be easily maintained. Returning crop residue to the soil and deferring tillage when the soil is wet help to maintain tilth.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The capability subclass is IIw.

60D2—Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on side slopes in the uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 5 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is silty clay about 55 inches thick. The upper part is brown and friable, the next part is mixed reddish brown and brown, mottled, and very firm, and the lower part is light reddish brown, mottled, and very firm. In some places the surface layer is more than 5 inches thick. In other places the subsoil and substratum are silty clay loam.

This soil is slowly permeable. It has a seasonal high water table. Runoff is rapid. Available water capacity is moderate or high. The content of organic matter in the surface layer is about 1.5 to 2 percent. The soil typically is neutral throughout. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. Some are pastured. In most areas this soil is managed along with adjacent soils. It is moderately suited to corn, soybeans, and small grain. It generally is suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. In some areas interceptor tile is needed upslope to reduce wetness and control seepage. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

66—Luton silty clay, 0 to 2 percent slopes. This nearly level, poorly drained or very poorly drained soil is at the lower elevations on broad bottom land. It is occasionally flooded for brief periods unless it is protected. Areas are irregularly shaped. They generally range from 5 to 75 acres in size, but some are as large as 200 acres.

Typically, the surface layer is black silty clay about 14 inches thick. The subsurface layer is very dark gray silty clay about 11 inches thick. The subsoil is very firm, calcareous silty clay about 19 inches thick. The upper part is very dark gray, and the lower part is dark gray and mottled. The substratum to a depth of about 60 inches is dark gray, mottled, calcareous silty clay. In places silt loam is below a depth of 40 inches.

Included with this soil in mapping are some small areas of the somewhat poorly drained Lakeport soils. These soils are slightly higher on the landscape than the Luton soil and dry out more rapidly after rains. Also, they can be tilled more easily. They make up less than 10 percent of the unit.

The Luton soil is very slowly permeable. It has a seasonal high water table. Runoff is very slow. Available water capacity is moderate. The content of organic matter in the surface layer is about 3 to 5 percent. The surface soil typically is neutral. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIw.

66+—Luton silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained or very poorly drained soil is at the lower elevations on broad bottom land. It is occasionally flooded for brief periods unless it is protected. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 11 inches thick. It is dark grayish brown

and grayish brown, calcareous silt loam. The underlying material to a depth of about 60 inches is silty clay. It is black in the upper 26 inches and dark gray and very dark gray in the lower part.

Included with this soil in mapping are some small areas of the somewhat poorly drained Moville soils. These soils are at elevations similar to those of the Luton soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Luton soil is very slowly permeable. It has a seasonal high water table. Runoff is very slow. Available water capacity is moderate. The content of organic matter in the surface layer is 1.5 to 2.5 percent. This layer typically is mildly alkaline or moderately alkaline. The underlying material generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

The capability subclass is IIIw.

67—Woodbury silty clay, 0 to 2 percent slopes. This nearly level, poorly drained or somewhat poorly drained soil is at the lower elevations on broad bottom land. It is commonly flooded for brief periods unless it is protected. Areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay about 13 inches thick. The subsurface layer is very dark gray, mottled silty clay about 10 inches thick. The subsoil is about 18 inches thick. It is firm and mottled. The upper part is very dark grayish brown silty clay, the next part is dark grayish brown silty clay, and the lower part is dark grayish brown silty clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and light olive brown silt loam. In places it is silty clay.

Included with this soil in mapping are small areas of Lakeport soils. These soils are slightly higher on the landscape than the Woodbury soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Woodbury soil is slowly permeable in the upper part and moderately permeable and moderately slowly permeable in the lower part. It has a seasonal high water table. Runoff is slow. Available water capacity is moderate or high. The content of organic matter in the surface layer is about 5 to 7 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIw.

70—McPaul silt loam, 0 to 2 percent slopes. This nearly level, well drained or moderately well drained soil is in settling basins on broad bottom land and in upland stream valleys. It is commonly flooded for very brief periods unless it is protected. In some areas it is protected by dikes and levees. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 200 acres.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and grayish brown, calcareous, stratified silt loam. In places it contains more clay in the upper part.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability class is I.

88—Nevin silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low alluvial terraces on bottom land. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 21 inches thick. The

subsoil is silty clay loam about 20 inches thick. The upper part is dark grayish brown and friable, the next part is dark grayish brown and brown and firm, and the lower part is brown, mottled, and friable. The substratum to a depth of about 60 inches is brown silt loam. In places the subsoil contains more clay.

This soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 4 to 6 percent. Reaction typically is slightly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains generally are not needed but are beneficial in some areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

93D2—Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping, moderately well drained or somewhat poorly drained soils are on upland side slopes. Areas range from 5 to 30 acres in size and are irregularly shaped. They are about 60 percent Shelby soil and 40 percent Adair soil. The two soils occur as areas so small or so intermingled that mapping them separately is impractical.

Typically, the Shelby soil has a surface layer of very dark gray clay loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is clay loam about 28 inches thick. The upper part is dark brown and friable, the next part is dark yellowish brown and friable, the lower part is brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown and dark yellowish brown, mottled clay loam. Stones and pebbles are in the subsoil and substratum. In some areas the surface layer is more than 7 inches thick. In other areas it is less than 7 inches thick because of erosion. In these areas stones and pebbles are on the surface. In places the soil is calcareous.

Typically, the Adair soil has a surface layer of black and very dark gray, friable clay loam about 6 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is mottled, very firm clay loam that extends to a depth of about 60 inches. The upper part is dark brown, dark reddish brown, and reddish brown; the next part is dark yellowish brown; and the lower part is dark yellowish brown and yellowish brown. A band of pebbles is at the base of the surface layer. Some pebbles are throughout the subsoil. In some places the surface layer is only about 3 inches thick because of severe erosion. In other places, it is more than 6 inches thick and no pebbles are in the subsoil or substratum.

Permeability is moderately slow or slow in the Shelby and Adair soils, and runoff is rapid. Available water capacity is high. The Adair soil has a seasonal high water table. The content of organic matter in the surface layer of both soils is about 1 to 2.5 percent. Reaction typically is medium acid in the surface layer and the upper part of the subsoil in the Shelby soil. It is neutral in the surface layer of the Adair soil and slightly acid in the upper part of the subsoil. The subsoil of the Shelby soil generally has a low supply of available phosphorus and a high supply of available potassium. That of the Adair soil has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. Some large areas are pastured. In most areas these soils are managed along with adjacent soils. They are poorly suited to corn, soybeans, and small grain. They are moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Tilth generally is fair in the surface layer. Returning crop residue to the soils or regularly adding other organic material and deferring tillage when the soils are wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soils in good condition.

The capability subclass is IVe.

99C—Exira silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 31 inches thick. It is friable. The upper part is brown silty clay loam, the next part is brown, mottled silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled light brownish gray and brown silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is medium acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

99C2—Exira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is about 28 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled light brownish gray and brown silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. Reaction typically is slightly acid in the surface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

99D—Exira silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 30 inches thick. It is friable. The upper part is brown silty clay loam, the next part is brown, mottled silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled light brownish gray and brown silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. Reaction typically is medium acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

99D2—Exira silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed

some of the subsoil with the surface layer. The subsoil is about 28 inches thick. It is friable. The upper part is brown silty clay loam, the next part is brown, mottled silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. Reaction typically is medium acid in the surface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

99D3—Exira silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on long side slopes in the uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark brown silty clay loam about 6 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is about 24 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled light brownish gray and brown silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. Reaction typically is medium acid in the surface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

99E2—Exira silty clay loam, 14 to 20 percent slopes, moderately eroded. This moderately steep, well drained soil is on side slopes in the uplands. Areas range from 5 to 15 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is about 22 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled light brownish gray and brown silt loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. Reaction typically is medium acid in the surface layer and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking

rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

112C2—Strahan silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on the sides and narrow tops of ridges in the uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown and very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some of the substratum with the surface layer. The substratum to a depth of about 60 inches is mottled brown, grayish brown, and yellowish brown silt loam. It is leached of carbonates to a depth of 36 inches or more. In some areas the soil is calcareous. In other areas it is silty clay loam throughout.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. Reaction typically is neutral in the surface layer and the upper part of the substratum. The substratum generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

112D2—Strahan silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on side slopes in the uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown and very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some of the substratum with the surface layer. The substratum to a depth of about 60 inches is mottled brown, grayish brown, and yellowish brown, friable silt loam. It is leached of carbonates to a depth of 36 inches or more. In some areas the soil is calcareous. In other areas it is silty clay loam throughout.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. Reaction typically is neutral in the surface layer and the upper part of the substratum. The substratum generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on bottom land. It is commonly flooded for very brief to long periods unless it is protected. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 300 acres.

Typically, the surface layer is black silty clay loam about 17 inches thick. The subsurface layer is black, firm silty clay loam about 14 inches thick. Below this is a transitional layer of very dark gray, firm silty clay loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown silty clay loam. In some places it is silty clay or is calcareous. In other places about 12 inches of recently deposited silt loam overlies the surface layer.

Included with this soil in mapping are small areas of the well drained or moderately well drained Judson soils and the moderately well drained Kennebec soils. These soils are slightly higher on the landscape than the Colo soil, can be tilled more easily, and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Colo soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. The soil typically is slightly acid throughout. The substratum generally has a medium supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

133+—Colo silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on bottom land. It is commonly flooded for very brief to long periods unless it is protected. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is very dark grayish brown or dark grayish brown silt loam. Below this is about 43 inches of black silty clay loam. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown, firm silty clay loam. In some places the underlying soil is calcareous throughout. In other places it is silt loam throughout.

Included with this soil in mapping are some small areas of the somewhat poorly drained and poorly drained Ackmore soils and the moderately well drained Rawles soils. These soils are slightly higher on the landscape than the Colo soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Colo soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 5 percent. This layer typically is neutral or mildly alkaline. The substratum generally has a medium supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

137—Haynie silt loam, 0 to 2 percent slopes. This nearly level, well drained or moderately well drained soil is at the higher elevations and on short escarpments in areas of recent deposition on bottom land. It is commonly flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 200 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The upper 28 inches of the substratum is brown, calcareous silt loam. The lower part to a depth of about 60 inches is brown, very friable, calcareous, stratified very fine sandy loam. In some places the surface layer and the upper part of the substratum are silty clay loam. In other places silty clay or sand is at a depth of about 30 inches.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability class is I.

144—Blake silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is at the intermediate elevations in areas of recent deposition on bottom land. It is occasionally flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 450 acres.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The upper 21 inches of the substratum is dark grayish brown, firm, calcareous silty clay loam. The lower part to a depth of about 60 inches is dark grayish brown and grayish brown, mottled, calcareous, stratified coarse silt loam. In places the surface layer is silt loam or silty clay.

This soil is moderately permeable in the upper part and moderately rapidly permeable or moderately permeable in the lower part. It has a seasonal high water

table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 3.0 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

146—Onawa silty clay, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is at the lower elevations in areas of recent deposition on bottom land. In most areas it is protected from flooding. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 200 acres.

Typically, the surface layer is very dark gray silty clay about 7 inches thick. The upper 21 inches of the substratum is dark grayish brown, calcareous silty clay. The lower part to a depth of about 60 inches is grayish brown and light brownish gray, mottled, calcareous, stratified silt loam. In some places the surface layer is silty clay loam. In other places the soil is silty clay throughout.

This soil is slowly permeable in the surface layer and the upper part of the substratum and moderately permeable or moderately rapidly permeable in the lower part of the substratum. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer, and clods form when the soil dries out. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

149—Modale silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained and somewhat poorly drained soil is at the higher elevations in areas of recent deposition on bottom land. It is commonly flooded for brief periods in areas on the river side of levees, but in other areas it is protected from flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 8 inches thick. The upper 20 inches of the substratum is brown and grayish brown, very calcareous, stratified silt loam. The lower part to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay. In some places the silt loam part of the substratum extends to a depth of more than 30 inches. In other places the surface layer is loamy fine sand.

This soil is moderately permeable in the surface layer and the upper part of the substratum and very slowly permeable or slowly permeable in the lower part of the substratum. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 3 percent. Reaction typically is mildly alkaline in the surface layer and the upper part of the substratum. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability class is I.

156—Albaton silty clay, 0 to 2 percent slopes. This nearly level, poorly drained soil is in swales and other low areas of recent deposition on bottom land. It is occasionally flooded for brief periods in areas on the river side of levees, but in other areas it is protected. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 400 acres.

Typically, the surface layer is very dark grayish brown, calcareous silty clay about 7 inches thick. The substratum to a depth of about 60 inches is olive gray and dark gray, mottled, calcareous, stratified silty clay. In places the lower part of the substratum is coarser textured.

This soil is very slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity

is moderate. The content of organic matter in the surface layer is about 1.5 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer, and large cracks and clods form when the soil dries out. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIw.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on convex side slopes in the uplands. Areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown clay loam about 6 inches thick. The subsurface layer is mixed brown and dark brown clay loam about 6 inches thick. The subsoil to a depth of about 60 inches is clay loam. It contains some pebbles throughout. The upper part is mottled dark brown and dark reddish brown and friable, the next part is reddish brown and firm, and the lower part is dark yellowish brown and yellowish brown, mottled, and very firm. In some places the surface layer is only about 3 inches thick because of severe erosion. In other places it is more than 7 inches thick.

This soil is slowly permeable. It has a seasonal high water table. Runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. Reaction typically is neutral in the surface soil and slightly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. Some large areas are pastured. In most areas this soil is managed along with adjacent soils. It is poorly suited to corn, soybeans, and small grain, mainly because it is subject to erosion. It is moderately suited to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

212—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom land. It is subject to rare flooding for brief periods unless it is protected. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 20 inches thick. The subsurface layer is very dark brown silt loam about 8 inches thick. Below this is a transitional layer of black, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown, mottled silt loam. In places about 12 inches of recently deposited silt loam overlies the surface layer.

Included with this soil in mapping are some small areas of the poorly drained Colo soils. These soils are slightly lower on the landscape than the Kennebec soil and dry out more slowly after rains. They make up less than 10 percent of the unit.

The Kennebec soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 4 to 6 percent. The soil typically is slightly acid or neutral throughout. The substratum generally has a low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

212+—Kennebec silt loam, overwash, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom land. It is frequently flooded for brief periods unless it is protected. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is dark grayish brown or grayish brown silt loam. Below this, in sequence downward, is about 20 inches of black silt loam, 8 inches of very dark brown silt loam, and 10 inches of black silt loam. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown, mottled, friable silt loam.

Included with this soil in mapping are small areas of the poorly drained, overwashed Colo soils and small

areas of Rawles soils. The overwashed Colo soils are slightly lower on the landscape than the Kennebec soil. Rawles soils are at elevations similar to those of the Kennebec soil and dry out more slowly after rains. Included soils make up less than 10 percent of the unit.

The Kennebec soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. This layer typically is moderately alkaline or neutral. The substratum generally has a low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on bottom land. It is frequently flooded for very brief or brief periods unless it is protected. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 300 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, grayish brown, and very dark grayish brown, stratified silt loam. In places dark silty clay loam is within a depth of 36 inches.

Included with this soil in mapping are some small areas of Kennebec soils and the well drained or moderately well drained, calcareous McPaul soils. These soils are at elevations similar to those of the Nodaway soil. Kennebec soils contain more organic matter in the surface layer than the Nodaway soil. Included soils make up less than 10 percent of the unit.

The Nodaway soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. The soil typically is neutral throughout. The substratum generally has a low supply of available phosphorus and a low or very low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Wetness is a limitation because of the flooding and the seasonal high water table. Measures that reduce the wetness improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability subclass is IIw.

234—Nishna silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in low depressional areas on bottom land. It is occasionally flooded unless it is protected. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black, calcareous silty clay loam about 8 inches thick. The subsurface layer is about 16 inches of black, calcareous silty clay loam and silty clay. The subsoil is very dark gray, firm, calcareous silty clay about 8 inches thick. The substratum to a depth of about 60 inches is dark gray, calcareous silty clay. In some places about 12 inches of recently deposited silt loam overlies the surface layer. In other places the soil is not calcareous or contains less clay between depths of 10 and 40 inches.

This soil is slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is about 4.5 to 6.5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for row crops. If adequately drained, this soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an outlet is available. Surface drains are needed to remove surface water in some areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil and deferring tillage when the soil is wet improve tilth.

If this soil is used for pasture, species that can grow well in a calcareous soil should be selected for planting. Overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The capability subclass is IIIw.

237—Sarpy loamy fine sand, 1 to 3 percent slopes. This very gently sloping, excessively drained soil is in areas of recent deposition on bottom land. It is subject to flooding in areas on the river side of levees, but in most areas it is protected. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is brown loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous fine sand. In some areas the surface layer is fine sandy loam.

Included with this soil in mapping are some small areas of the well drained or somewhat excessively drained Grable soils. These soils are at elevations similar to those of the Sarpy soil. They have a silt loam surface layer and a moderate available water capacity. They make up less than 10 percent of the unit.

Permeability is rapid in the Sarpy soil, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 0.5 to 1 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The low available water capacity is the main limitation. Also, wind erosion is a hazard. It can be controlled, however, by windbreaks, by artificial barriers, such as snow fences, by mulch tillage, and by a cover of crop residue. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility. A cover of pasture plants or hay is effective in controlling wind erosion. Overgrazing, however, greatly increases the susceptibility to wind erosion.

The capability subclass is IVs.

238—Sarpy fine sandy loam, 0 to 2 percent slopes. This nearly level, excessively drained soil is in areas of recent deposition on bottom land. It is subject to flooding in areas on the river side of levees, but in most areas it is protected. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, calcareous fine sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is grayish brown, calcareous fine sand. In places the surface layer is loamy fine sand.

Included with this soil in mapping are some small areas of the well drained or somewhat excessively drained Grable soils. These soils are at elevations similar to those of the Sarpy soil. They have a moderate available water capacity. They make up less than 10 percent of the unit.

Permeability is rapid in the Sarpy soil, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 0.5 to 1 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The very rapid rate of water intake and the low available water capacity are the main limitations. Also, wind erosion is a hazard. It can be controlled, however, by artificial barriers, such as snow fences, by mulch tillage, and by a cover of crop residue. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and improves fertility.

A cover of pasture plants or hay is effective in controlling wind erosion. Overgrazing, however, greatly increases the susceptibility to wind erosion.

The capability subclass is IVs.

244—Blend silty clay, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad bottom land. It is subject to rare flooding. Areas range from 5 to 35 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay about 10 inches thick. The subsurface layer is very dark gray, mottled silty clay about 7 inches thick. The subsoil is dark grayish brown, friable silty clay loam about 12 inches thick. Below this to a depth of about 60 inches is a buried layer of dark gray, mottled, calcareous silty clay. In places the subsoil is silty clay.

Included with this soil in mapping are some small areas of the poorly drained or somewhat poorly drained Woodbury soils. These soils are at elevations similar to those of the Blend soil. They make up less than 10 percent of the unit.

The Blend soil is very slowly permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is about 3 to 5 percent. The surface soil typically is medium acid or slightly acid. The subsoil generally has a very low or low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIIw.

255—Cooper silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is at the intermediate elevations on bottom land. It is subject to rare flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is very dark

grayish brown silty clay loam about 7 inches thick. The subsoil is dark grayish brown, friable, calcareous silty clay loam about 13 inches thick. Below this to a depth of about 60 inches is a buried layer of very dark gray and olive gray, calcareous silty clay. In places the soil is moderately well drained.

Included with this soil in mapping are some small areas of the well drained or moderately well drained Keg soils. These soils are higher on the landscape than the Cooper soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Cooper soil is moderately permeable in the upper part and slowly permeable in the underlying buried layer. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and mildly alkaline in the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

275—Moville silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad bottom land. It is commonly flooded for brief periods unless it is protected. Areas range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 7 inches thick. The substratum is dark grayish brown, gray, grayish brown, and very dark gray, stratified silt loam about 18 inches thick. Below this to a depth of about 60 inches is a buried layer of black, very dark gray, olive gray, and dark gray silty clay. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of Luton soils. These soils are more poorly drained than the Moville soil and stay wet for longer periods after rains. They make up less than 10 percent of the unit.

The Moville soil is moderately permeable in the upper part and very slowly permeable in the underlying buried layer. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. Reaction typically is mildly alkaline or moderately alkaline in the surface layer and substratum. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability subclass is IIw.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is on bottom land. It is frequently flooded for very brief or brief periods unless it is protected. Areas are irregularly shaped. They generally range from 5 to 50 acres in size, but some are as large as 100 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The substratum is very dark grayish brown and dark grayish brown, stratified silt loam about 17 inches thick. Below this to a depth of about 60 inches is a buried layer of black silty clay loam. In places the soil is silt loam to a depth of 40 inches.

Included with this soil in mapping are some small areas of the poorly drained Colo soils. These soils are lower on the landscape than the Ackmore soil and dry out more slowly after rains. Also, they have a higher organic matter content. They make up less than 10 percent of the unit.

The Ackmore soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 3 percent. Reaction typically is medium acid to neutral in the surface layer and substratum. The substratum generally has a low supply of available phosphorus and a low or very low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability subclass is IIw.

436—Lakeport silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is at the intermediate elevations on bottom land. It is subject to rare flooding. Areas are irregularly shaped. They generally range from 5 to 100 acres in size, but some are as large as 450 acres.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 12 inches thick. The subsoil is silty clay loam about 27 inches thick. The upper part is dark gray, mottled, and firm; the next part is dark grayish brown and firm; and the lower part is grayish brown, mottled, and friable. The substratum to a depth of about 60 inches is light brownish gray, mottled, calcareous coarse silt loam. In some places silt loam is within a depth of 30 inches. In other places the surface layer is silty clay.

This soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and mildly alkaline or moderately alkaline in the subsoil. The subsoil generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

509—Marshall silty clay loam, benches, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is brown, grayish brown, and yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In places the loess is underlain by sandy alluvial sediments.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. Reaction typically is slightly acid in the surface soil and subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to control erosion and prevent surface crusting, and increase the rate of water infiltration.

The capability class is I.

509B—Marshall silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is brown, grayish brown, and yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In some areas the loess is underlain by sandy alluvial sediments.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4.5 percent. Reaction typically is slightly acid in the surface soil and subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

509C—Marshall silty clay loam, benches, 5 to 9 percent slopes. This moderately sloping, well drained soil is on the sides of loess-covered stream benches.

Areas range from 5 to 25 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is black and very dark brown silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 30 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is brown, grayish brown, and yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. The loess is underlain by alluvial sediments of varying textures. Sandy material is exposed on some of the side slopes.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is slightly acid in the surface soil and subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

509C2—Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on the sides of loess-covered stream benches. Areas range from 5 to 25 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Plowing has mixed some of the subsoil with the surface layer. The subsoil is about 30 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is brown, grayish brown, and yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In places the surface layer is more than 8 inches thick. The loess is underlain by alluvial sediments of varying textures. Sandy material is exposed on some of the side slopes.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. Reaction typically is slightly acid in the surface layer and subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

510B—Monona silt loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on loess-covered stream benches. Areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 7 inches thick. The subsoil is brown, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. The loess is underlain by sandy alluvial sediments. In places the surface soil and subsoil are silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and subsoil. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

514—Grable silt loam, 0 to 2 percent slopes. This nearly level, well drained or somewhat excessively drained soil is in the slightly higher areas of recent deposition on bottom land. It is commonly flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The upper part of the substratum is dark grayish brown and grayish brown, calcareous, stratified silt loam. The lower part to a depth of about 60 inches is grayish brown, loose, calcareous fine sand. In some places the soil is silt loam to a depth of 40 inches. In other places the surface layer is silty clay.

Included with this soil in mapping are some small areas of Sarpy and Vore soils. Sarpy soils are at elevations similar to those of the Grable soil. Their available water capacity is low. Vore soils are slightly lower on the landscape than the Grable soil and dry out more slowly after rains. Included soils make up less than 10 percent of the unit.

The Grable soil is moderately permeable in the surface layer and the upper part of the substratum and rapidly permeable in the lower part. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is about 1.5 to 3 percent. Reaction typically is neutral or mildly alkaline in the surface layer and moderately alkaline in the substratum. The substratum generally has a very low or low supply of available phosphorus and a low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability subclass is IIs.

515—Percival silty clay, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is at the lower elevations in depressional areas of recent deposition on bottom land. It is commonly flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas range from 5 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silty clay about 7 inches thick. The upper part of the substratum is dark gray, calcareous silty clay. The lower part to a depth of about 60 inches is grayish brown, calcareous fine sand. In some places it is silt loam or silty clay. In other places the surface layer is silty clay loam.

This soil is slowly permeable in the surface layer and the upper part of the substratum and rapidly permeable in the lower part. It has a seasonal high water table. Runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer, and clods form when the soil dries out. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

516—Vore silty clay loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is at the intermediate elevations in areas of recent deposition on bottom land. It is commonly flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas range from 5 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silty clay loam about 7 inches thick. The upper part of the substratum is dark grayish brown and grayish brown, friable, calcareous, stratified silty clay loam. The lower part to a depth of about 60 inches is grayish brown, calcareous fine sand. In places the surface layer is silt loam or silty clay.

This soil is moderately permeable in the surface layer and the upper part of the substratum and rapidly permeable in the lower part. It has a seasonal high water table. Runoff is slow. Available water capacity is low or moderate. The content of organic matter in the surface layer is about 2 to 3 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIs.

555—Percival silty clay, dark surface, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is at the lower elevations on bottom lands. It is commonly flooded for very brief periods in areas on the river side of levees, but in other areas it is protected. Areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay about 7 inches thick. The subsurface layer is black silty clay about 6 inches thick. The upper part of the substratum is dark gray, mottled, calcareous silty clay. The lower part to a depth of about 60 inches is dark yellowish brown and light brownish gray, calcareous fine sand.

Included with this soil in mapping are some small areas of the somewhat poorly drained or poorly drained Blencoe soils. These soils are slightly higher on the landscape than the Percival soil. They make up less than 10 percent of the unit.

The Percival soil is slowly permeable in the surface layer and the upper part of the substratum and rapidly permeable in the lower part. It has a seasonal high water table. Runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 3 to 5 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Land grading and surface drains reduce the wetness in most areas. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

636—Buckney fine sandy loam, 0 to 2 percent slopes. This nearly level, excessively drained soil is at the higher elevations on bottom land. It is subject to rare flooding. Areas range from 5 to 20 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown fine sandy loam about 14 inches thick. The subsurface layer is dark brown, calcareous fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is calcareous loamy fine sand. It is dark yellowish brown in the upper part and grayish brown in the lower part.

Permeability is rapid, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The surface soil and the upper part of the substratum typically are neutral or mildly alkaline. The substratum generally has a very low supply of available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. The low available water capacity is the main limitation. Also, wind erosion is a hazard. It can be controlled, however, by windbreaks, by artificial barriers, such as snow fences, by mulch tillage, and by a cover of crop residue. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility.

A cover of pasture plants or hay is effective in controlling wind erosion. Overgrazing, however, greatly increases the susceptibility to wind erosion.

The capability subclass is IIIs.

670—Rawles silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom land. It is frequently flooded for brief periods unless it is protected. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The substratum is very dark grayish brown and dark grayish brown, calcareous, stratified silt loam about 18 inches thick. Below this to a depth of about 60 inches is a buried layer of silt loam. The upper part of this layer is black, and the lower part is very dark brown. In some places, the soil is noncalcareous and the buried layer is silty clay loam. In other places the thickness of the surface layer combined with that of the substratum is less than 18 inches.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 3 percent. Reaction typically is mildly alkaline or moderately alkaline in the surface layer and substratum. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. If the soil is used for pasture, overgrazing reduces forage production.

The capability subclass is IIw.

717—Napier-Gullied land complex, 2 to 10 percent slopes. This gently sloping to strongly sloping map unit occurs as areas of a well drained Napier soil intermingled with large gullies. It is in upland drainageways. Areas range from 5 to 50 acres in size and are narrow and irregularly shaped. They are about 55 percent Napier soil and 45 percent Gullied land. The areas of Napier soil and Gullied land are so intermingled that mapping them separately is impractical.

Typically, the surface layer of the Napier soil is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 23 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown and brown, friable silt loam. In places the soil is calcareous.

Typically, the gullies are deep and wide and are subject to cutting by water in the drainageways. The sides are subject to sloughing because they generally are vertical.

Permeability is moderate in the Napier soil, and runoff varies. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

This map unit is unsuited to corn, soybeans, and small grain. In some small areas it is moderately suited to grasses and legumes for hay and pasture. The gullies severely limit all uses. Controlling the formation or enlargement of the gullies is difficult and generally involves considerable earthmoving. Trees grow in many of the gullies.

The capability subclass is VIIe.

733—Calco silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained or very poorly drained soil is in depressions and swales on bottom land. It is frequently flooded for brief periods unless it is protected. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsurface layer is black, calcareous silty clay loam about 24 inches thick. The subsoil is very dark gray, friable, calcareous silty clay loam about 7 inches thick. The substratum to a depth of about 60 inches is dark gray and gray, mottled, calcareous silty clay loam. In some places about 12 inches of recently deposited silt loam overlies the surface layer. In other places, the soil is not calcareous and the subsoil is silty clay.

This soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. The soil typically is mildly alkaline or moderately alkaline throughout. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, species that can grow well in a calcareous soil should be selected for planting. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

849—Kenmoor loamy fine sand, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on bottom land. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous loamy fine sand about 8 inches thick. The substratum is brown, calcareous loamy fine sand about 16 inches thick. Below this to a depth of about 60 inches is a buried layer of very dark grayish brown and dark grayish brown, calcareous silty clay. In places the soil is excessively drained.

This soil is rapidly permeable in the surface layer and the substratum and slowly permeable in the underlying buried layer. It has a seasonal high water table. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is less than 1 percent. Reaction typically is mildly alkaline or moderately alkaline in the surface layer and substratum. The substratum generally has a very low supply of

available phosphorus and a high supply of available potassium.

Most areas are used for row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. Droughtiness is a limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. It can be controlled, however, by windbreaks, by artificial barriers, such as snow fences, by mulch tillage, and by a cover of crop residue. Tilth generally is poor in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility.

A cover of pasture plants or hay is effective in controlling wind erosion. Overgrazing, however, greatly increases the susceptibility to wind erosion.

The capability subclass is IIIs.

1233—Corley silt loam, 0 to 1 percent slopes. This nearly level, poorly drained soil is in depressional areas on loess-covered stream benches. It is occasionally ponded for brief periods. Areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 10 inches thick. The subsurface layer is very dark gray and dark gray silt loam about 19 inches thick. The subsoil is about 31 inches thick. The upper part is very dark gray, firm silt loam, the next part is dark gray, firm silty clay loam, and the lower part is dark gray, mottled, firm silty clay loam. The substratum to a depth of about 68 inches is olive gray, mottled silt loam. The loess is underlain by alluvial sediments of varying textures.

Included with this soil in mapping are some small areas of the somewhat poorly drained Minden soils. These soils are slightly higher on the landscape than the Corley soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

The Corley soil is moderately permeable. It has a seasonal high water table. Runoff is very slow or ponded. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. Reaction typically is strongly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It generally is surrounded by a larger area of soils that are adequately drained. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. In many areas, however, deep cuts are needed to provide suitable outlets for tile or surface drains. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability subclass is IIw.

1299—Minden silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess-covered stream benches. Areas range from 5 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 13 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, friable silty clay loam about 22 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled silt loam. The loess is underlain by alluvial sediments of varying textures. In some areas the subsoil is yellowish brown. In other areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the poorly drained Corley soils. These soils are slightly lower on the landscape than the Minden soil and are ponded after rains. They make up less than 10 percent of the unit.

The Minden soil is moderately permeable. It has a seasonal high water table. Runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 4 to 5 percent. Reaction typically is slightly acid or medium acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains generally are not needed but are beneficial in some areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The capability class is I.

5030—Pits and dumps, quarry. These are excavations from which sand, gravel, and limestone have been removed. Areas range from 5 to 50 acres in size.

Many areas where sand and gravel have been removed are filled with water. Included in these areas are sandy waste material and stockpiles of sand. Windblown sand is common around the pits. It can be controlled by planting grasses and trees.

The quarries generally have very steep sides made up of limestone or soil material. Some of the inactive ones are filled with water.

This map unit is not suited to cultivation or grazing unless vegetation is reestablished. Part of the overburden and spoil banks can be leveled and planted to grasses or trees. Because soil properties and physical conditions vary, onsite investigation is needed before any decisions can be made about farm or nonfarm uses of specific areas.

No capability class or subclass is assigned.

5040—Orthents, loamy. These soils have been leveled, reshaped, or transported during the development of industrial sites and of sites for dwellings and highways. They have been so altered that the soil series cannot be identified. In most places the landscape has also been altered. Areas range from 5 to 25 acres in size.

The soil material dominantly is silt loam and silty clay loam. In some areas so much of the soil material has been removed that calcareous silt loam is exposed.

Included with these soils in mapping are some areas of fill, where cement, bricks, and trash were covered with soil material and then compacted and leveled. These areas are used as building sites, railroad yards, and highways.

Erosion is the main hazard in the newly cut and filled areas. Because soil properties and physical conditions vary, onsite investigation is needed before any decisions can be made about farm or nonfarm uses of specific areas.

No capability class or subclass is assigned.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber or is available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 145,000 acres throughout Mills County, or about 50 percent of the total acreage, meets the requirements for prime farmland. Crops are grown on about 140,000 acres of the prime farmland. They account for an estimated two-thirds of the local agricultural income each year. They are mainly corn and soybeans.

A recent trend in some parts of the county is the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate and are less productive.

The map units that meet the requirements for prime farmland in Mills County are listed in this section. Some of the map units meet the requirements only in areas where the soil is drained or protected from flooding, or both. Onsite investigation is needed to determine whether or not a specific area of the soil is adequately drained or protected. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units." The map units that are considered prime farmland are:

430—Ackmore silt loam, 0 to 2 percent slopes (where drained and protected from flooding)
144—Blake silty clay loam, 0 to 2 percent slopes
44—Blencoe silty clay, 0 to 2 percent slopes (where drained)
244—Blend silty clay, 0 to 2 percent slopes (where drained)
43—Bremer silty clay loam, 0 to 2 percent slopes (where drained)
733—Calco silty clay loam, 0 to 2 percent slopes (where drained and protected from flooding)
133+—Colo silt loam, overwash, 0 to 2 percent slopes (where drained and protected from flooding)
133—Colo silty clay loam, 0 to 2 percent slopes (where drained and protected from flooding)
11B—Colo-Judson silty clay loams, 2 to 5 percent slopes (where drained and protected from flooding)
255—Cooper silty clay loam, 0 to 2 percent slopes

1233—Corley silt loam, 0 to 1 percent slopes (where drained)
514—Grable silt loam, 0 to 2 percent slopes
137—Haynie silt loam, 0 to 2 percent slopes (where protected from flooding)
8B—Judson silty clay loam, 2 to 5 percent slopes
46—Keg silt loam, 0 to 2 percent slopes
212—Kennebec silt loam, 0 to 2 percent slopes
212+—Kennebec silt loam, overwash, 0 to 2 percent slopes (where protected from flooding)
436—Lakeport silty clay loam, 0 to 2 percent slopes
9—Marshall silty clay loam, 0 to 2 percent slopes
9B—Marshall silty clay loam, 2 to 5 percent slopes
509—Marshall silty clay loam, benches, 0 to 2 percent slopes
509B—Marshall silty clay loam, benches, 2 to 5 percent slopes
70—McPaul silt loam, 0 to 2 percent slopes (where protected from flooding)
1299—Minden silty clay loam, 0 to 2 percent slopes
149—Modale silt loam, 0 to 2 percent slopes (where drained and protected from flooding)
10B—Monona silt loam, 2 to 5 percent slopes
510B—Monona silt loam, benches, 2 to 5 percent slopes
275—Moville silt loam, 0 to 2 percent slopes (where drained and protected from flooding)
12B—Napier silt loam, 2 to 5 percent slopes
88—Nevin silty clay loam, 0 to 2 percent slopes
234—Nishna silty clay loam, 0 to 2 percent slopes (where drained)
220—Nodaway silt loam, 0 to 2 percent slopes (where protected from flooding)
146—Onawa silty clay, 0 to 2 percent slopes (where drained and protected from flooding)
670—Rawles silt loam, 0 to 2 percent slopes (where protected from flooding)
36—Salix silty clay loam, 0 to 2 percent slopes
516—Vore silty clay loam, 0 to 2 percent slopes (where protected from flooding)
54+—Zook silt loam, overwash, 0 to 2 percent slopes (where drained and protected from flooding)
54—Zook silty clay loam, 0 to 2 percent slopes (where drained and protected from flooding)

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1975, more than 223,000 acres in Mills County was used for crops and pasture (*7*). Of this total, about 32,000 acres was used for permanent pasture; 101,700 acres for corn; 67,500 acres for soybeans; 12,500 acres for wheat and oats; and 9,400 acres for rotation hay and pasture. The acreage used for crops and pasture has been gradually decreasing because the acreage used for urban development has been increasing.

The paragraphs that follow describe the main management concerns in the areas used for crops and pasture.

Soil erosion is the major problem on about two-thirds of the cropland and pasture in the county. If the slope is more than 2 percent, erosion is a hazard.

Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Adair and Malvern soils. Control of erosion helps to maintain the productivity of soils and improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

In clayey spots on many sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded away. Such spots are common in areas of the moderately eroded Adair and Malvern soils.

Erosion control provides a protective plant cover, reduces the runoff rate, and increases the infiltration rate. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is pasture and hayland, including legumes and grasses in the cropping system not only provides nitrogen and improves tilth for the following crops but also reduces the risk of erosion on the more sloping soils.

Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These practices are suited to most of the upland soils. No-tillage or

another kind of conservation tillage is effective in controlling erosion on most of the more sloping soils used for row crops.

Following are examples of the major kinds of conservation tillage. No-tillage is a system in which the seedbed is prepared and the seed planted in one operation. The surface is disturbed only in the immediate area of the planted seed row. A protective cover of crop residue is left on at least 90 percent of the surface. Site-plant also is a system in which the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the row. A protective cover of crop residue is left on two-thirds of the surface. Chisel-disk or rotary tillage is a system in which the soil is loosened throughout the field and crop residue is partly incorporated into the soil. Preparing the seedbed and planting can be one or separate operations. Conservation tillage is not practical unless enough crop residue is left on the surface after planting to control erosion.

Terraces (fig. 12) and diversions reduce the length of slopes and the hazards of runoff and erosion. They are most practical on soils that have regular slopes. Marshall and Monona soils are suitable for terracing. Other soils are less suitable for terraces and diversions because slopes are irregular.

Contour farming commonly is effective in controlling erosion in the county. It is most effective in areas where slopes are smooth and uniform, including many areas of Marshall, Monona, and Ida soils.

Wind erosion is a hazard on the sandy Buckney, Kenmoor, and Sarpy soils. It can damage these soils in a few hours if winds are strong and the soils are dry and have no plant cover or surface mulch. Maintaining a plant cover or surface mulch and keeping the surface rough through proper tillage minimize the damage caused by wind erosion on all of these soils. Windbreaks of suitable trees and shrubs also are effective in controlling wind erosion.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is a major problem on about one-third of the cropped areas on bottom land in the county. Some soils are naturally so wet that the production of crops is difficult in wet years. Examples are the poorly drained or very poorly drained Calco and Luton soils and the poorly drained Albaton, Blend, Bremer, Colo, Corley, Nishna, and Zook soils, which make up about 18,000 acres in the county. Most of these soils are drained by surface drains and a network of drainage ditches. A system of

Figure 12.—Terraces in an area of Monona silt loam, 9 to 14 percent slopes.

cropping or land leveling that enhances the drainage is beneficial on these soils.

The poorly drained or somewhat poorly drained Ackmore, Blencoe, Onawa, and Woodbury soils are wet part of the year. They make up about 5,000 acres in the county. A drainage system is needed to increase the productivity of these soils. It also is needed in the somewhat poorly drained Blake, Cooper, Lakeport, Minden, Nevin, and Percival soils, which make up about 9,000 acres in the county, and in the somewhat poorly drained or moderately well drained Modale and Moville soils, which make up about 2,000 acres. Kenmoor, Kennebec, Nodaway, Rawles, and Vore soils are moderately well drained and tend to dry out slowly after rains. They make up about 15,000 acres in the county. A drainage system is needed in some areas of these soils. It generally is not needed in areas of the well drained or moderately well drained Haynie, Keg, and McPaul soils, which make up about 10,000 acres in the county.

The design of both surface and subsurface drainage systems varies with the kind of soil. Surface drains are needed in most areas of the poorly drained or very poorly drained soils that are intensively row cropped. Finding adequate outlets for tile drainage systems is very difficult in areas on the bottom land along the Missouri River. Most of these areas are drained by surface drains and drainage ditches. Even if adequate outlets are available, tile drainage is very slow in the Bremer, Colo, Nishna, and Zook soils.

Information about the design of drainage systems for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Irrigation generally is restricted to the valley of the Missouri River. The acreage of irrigated cropland is small but is increasing. It can be further increased in areas where an adequate amount of underground water is available. Water for irrigated land generally comes from wells. It is used primarily to supplement natural rainfall during dry years. During normal years, less irrigation is needed. Nearly level or very gently sloping soils are best suited to irrigation. Much water is lost if the more sloping soils are irrigated. Also, the excessive runoff causes erosion.

Irrigated fields should be managed not only so that crops grow well but also so that water is not wasted. The methods of irrigation used in this county are furrow irrigation, in which water runs down the plant rows, and sprinkler irrigation, in which the water is applied at a rate that is adjusted to the intake rate of the soil. The interval between applications is determined by the kind of crop that is grown, the time of the year, and the available water capacity of the soil. The soil should be kept moist throughout the growing season. The application rate should not exceed the intake rate of the soil.

Assistance in planning and laying out an irrigation system is available at the local office of the Soil Conservation Service or the Cooperative Extension Service. Estimates concerning cost of equipment can be obtained from local dealers and manufacturers of irrigation equipment.

Irrigation generally increases the productivity of the soil, but more plant nutrients are removed when the crop is harvested. Returning all crop residue to the soil, adding manure, and applying fertilizer help to replenish the plant nutrients. If the surface is disturbed during land leveling, the crops respond to additions of certain nutrients. The kind and amount of fertilizer needed for specific crops should be determined by soil tests.

Soil fertility is affected by reaction and by the content of plant nutrients. It is low in most of the eroded soils on uplands. The content of organic matter varies in the upland soils according to the extent of erosion. The Castana, Dow, Hamburg, and Ida soils on uplands are naturally alkaline. Applications of lime are not needed on these soils or on the Judson, Monona, and Napier soils, which generally are neutral. The soils on bottom land, such as Albaton, Blake, Blencoe, Colo, Haynie, Luton, Nodaway, Percival, and Zook soils, range from medium acid to moderately alkaline and vary widely in content of plant nutrients. Most of these soils have a naturally low supply of available phosphorus. About one-third of them have a low supply of potash.

Applications of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are friable and porous.

Most of the upland soils used for crops have a surface layer of silt loam or silty clay loam. Those that are eroded are low in content of organic matter. The rate of water infiltration is good in most of the upland soils, except for the very steep ones or the ones that have a clayey surface layer and subsoil. Under certain conditions, a crust forms on the surface of these soils. Regularly adding crop residue and other organic material improves tilth and helps to prevent surface crusting.

Fall plowing generally is not suitable on the more sloping soils because it increases the susceptibility to water erosion. It may be beneficial, however, on the clayey soils on bottom land, which often stay wet until late in the spring.

The field crops suited to the soils and climate of Mills County include corn, soybeans, oats, wheat, and grain sorghum. They also include sugar beets, sunflowers, and other crops that are not commonly grown in the county.

The only specialty crops grown in the county are apples. These are grown in a few orchards. In 1900, 111,690 bushels of apples and 161,400 pounds of grapes were harvested from a large number of orchards. These crops could be extensively grown again if

economic conditions were to become favorable. The better drained soils that warm up early in spring are especially well suited to many of the vegetables and small fruits. They are the Castana, Haynie, Ida, Keg, and Monona soils, which total about 50,000 acres in the county.

The latest information and suggestions about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

In areas used for pasture and hay, good management is needed for maximum production. In established stands it includes applications of fertilizer, weed and bush control, pasture rotation, timely deferment of grazing, proper stocking rates, and well distributed livestock watering facilities. Erosion is a severe hazard if the plant cover is removed when the more sloping areas are renovated. If cultivated crops are grown prior to seeding, soil losses can be reduced by a conservation tillage system that leaves a protective amount of crop residue on the surface, by contour farming, and by grassed waterways. Interseeding grasses and legumes into existing sod eliminates the need for removing the plant cover during seedbed preparation.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the

surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation

of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as a high content of calcium carbonate. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion,

an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate,

except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most

susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate, or high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*15*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Hapludolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*15*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Ackmore series

The Ackmore series consists of somewhat poorly drained or poorly drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Ackmore soils are similar to Nodaway and Rawles soils and commonly are adjacent to Colo, Kennebec, and Nodaway soils. All of the similar and adjacent soils are on bottom land. Colo and Kennebec soils have a mollic epipedon. Nodaway soils do not have a buried A

horizon. They are moderately well drained. Rawles soils are calcareous.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, 650 feet west and 1,200 feet south of the northeast corner of sec. 8, T. 71 N., R. 41 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

C—7 to 24 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam; few yellowish brown (10YR 5/6) mottles; weak thin platelike structure because of stratification; very friable; neutral; abrupt smooth boundary.

IIA11b—24 to 33 inches; black (10YR 2/1) silty clay loam; weak fine and very fine subangular blocky structure; friable; dark grayish brown (10YR 4/2) silt loam fillings in cracks; neutral; clear smooth boundary.

IIA12b—33 to 43 inches; black (10YR 2/1) silty clay loam; weak very fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

IIA13b—43 to 60 inches; black (10YR 2/1) silty clay loam; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine dark concretions; slightly acid.

The A horizon, or the solum, is less than 10 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It ranges from medium acid to neutral. The C horizon has value of 2 to 5 and chroma of 1 or 2. It ranges from medium acid to neutral. The depth to the IIAb horizon ranges from 20 to 36 inches. This horizon has value of 2 or 3 and chroma of 0 or 1. It ranges from 27 to 36 percent clay. It ranges from medium acid to mildly alkaline.

Adair series

The Adair series consists of moderately well drained or somewhat poorly drained, slowly permeable soils formed in glacial till on uplands. Slope ranges from 9 to 14 percent.

Adair soils are similar to Malvern and Shelby soils and commonly are adjacent to Malvern, Marshall, and Shelby soils. Malvern soils contain less sand in the upper part of the solum than the Adair soils. Also, they are higher on the landscape. Marshall soils contain more silt and less clay than the Adair soils and formed in loess on the higher slopes. Shelby soils are downslope from the Adair soils. The upper part of their B horizon has hue of 10YR and does not have reddish mottles.

Typical pedon of Adair clay loam, 9 to 14 percent slopes, moderately eroded, 945 feet east and 85 feet north of the southwest corner of sec. 20, T. 71 N., R. 40 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few roots; neutral; clear smooth boundary.

A3—6 to 12 inches; mixed dark brown (7.5YR 3/2) and brown (7.5YR 4/4) clay loam, brown (7.5YR 5/2) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

IIB21t—12 to 20 inches; mottled dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4) clay loam; moderate fine subangular blocky structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

IIB22t—20 to 32 inches; reddish brown (5YR 4/4) clay loam; weak medium prismatic structure parting to moderate fine subangular blocky; firm; few thin discontinuous clay films; common fine pebbles and sand grains; few fine dark concretions; slightly acid; gradual smooth boundary.

IIB31t—32 to 41 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/6 and 5/8) and few fine or medium faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak and moderate medium subangular blocky; very firm; few thin discontinuous clay films; few fine pebbles; few fine dark concretions; neutral; gradual smooth boundary.

IIB32—41 to 60 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; many medium faint light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) mottles; weak medium angular blocky structure; very firm; few fine dark concretions; neutral.

The thickness of the solum ranges from 40 to 60 inches. The mollic epipedon is 10 to 14 inches thick.

The A horizon dominantly has value of 2 or 3 and chroma of 1 or 2. In many pedons, however, the A3 horizon has value and chroma of as much as 4. The B horizon has value of 3 to 5 and chroma of 4 or 6. The C horizon has value of 4 or 5 and chroma of 4 or 6.

Albaton series

The Albaton series consists of poorly drained, very slowly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Albaton soils are similar to Onawa and Percival soils and commonly are adjacent to Haynie, Modale, Onawa, and Percival soils. Onawa soils are medium textured in the lower part of the control section. They are in positions on the landscape similar to those of the Albaton soils. Haynie and Modale soils are medium textured in the upper part of the control section. They are at the higher elevations. Percival soils are coarse textured in the lower part of the control section. They are in positions on the landscape similar to those of the Albaton soils.

Typical pedon of Albaton silty clay, 0 to 2 percent slopes, 1,080 feet west and 93 feet south of the northeast corner of sec. 1, T. 73 N., R. 44 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate very fine and fine subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—7 to 60 inches; stratified olive gray (5Y 4/2) and dark gray (5Y 4/1) silty clay; common fine distinct olive brown (2.5Y 4/4) and brown (10YR 4/3) mottles; moderate fine subangular blocky structure; some horizontal cleavage planes between strata; firm; few thin strata of silt loam below a depth of 40 inches; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. The Cg horizon has value of 3 to 5 and chroma of 1 or 2.

Blake series

The Blake series consists of somewhat poorly drained soils formed in alluvium on bottom land. Permeability is moderate in the upper part of the profile and moderate or moderately rapid in the lower part. Slope ranges from 0 to 2 percent.

Blake soils are similar to Haynie, Onawa, and Vore soils and commonly are adjacent to those soils. Haynie soils are coarser textured in the upper part of the control section than the Blake soils. Onawa soils are fine textured in the upper part of the control section. Vore soils are coarse textured in the lower part of the control section. Haynie and Vore soils are at the higher elevations, and Onawa soils are in positions on the landscape similar to those of the Blake soils.

Typical pedon of Blake silty clay loam, 0 to 2 percent slopes, 90 feet east and 2,000 feet north of the southwest corner of sec. 30, T. 72 N., R. 43 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak to moderate very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; abrupt smooth boundary..

C1—8 to 29 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate to weak fine subangular blocky structure; firm; few fine faint dark yellowish brown (10YR 4/4) mottles; few secondary carbonates; strong effervescence; mildly alkaline; clear smooth boundary.

IIC2—29 to 60 inches; stratified dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) coarse silt loam; common fine faint yellowish brown (10YR 5/4) and light gray (10YR 6/1) mottles; some horizontal cleavage; very friable; a 4-inch stratum of fine sand at a depth of 55 inches; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 or 4 and chroma of 1 or 2. The C1 horizon has value of 4 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. The depth to the IIC horizon ranges from 18 to 30 inches. This horizon has value of 4 or 5 and chroma of 2. It is coarse silt loam or very fine sandy loam that has thin strata of other textures. It is mildly alkaline or moderately alkaline.

Blencoe series

The Blencoe series consists of somewhat poorly drained or poorly drained soils formed in alluvium on bottom land. Permeability is slow in the upper part of the profile and moderate in the lower part. Slope ranges from 0 to 2 percent.

Blencoe soils are similar to Blend, Lakeport, Luton, and Woodbury soils and commonly are adjacent to those soils. They are slightly higher on the landscape than those soils. Blend and Woodbury soils are fine textured in the lower part of the control section. Lakeport soils are coarser textured in the control section than the Blencoe soils. Luton soils are fine textured throughout the control section.

Typical pedon of Blencoe silty clay, 0 to 2 percent slopes, 1,500 feet east and 380 feet north of the southwest corner of sec. 22, T. 72 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine or very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

B1—15 to 21 inches; very dark grayish brown (10YR 3/2) silty clay; common fine faint brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; firm; neutral; clear smooth boundary.

B2—21 to 28 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

IIB3—28 to 33 inches; dark grayish brown (2.5Y 4/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

IIC1—33 to 60 inches; grayish brown (2.5Y 5/2) coarse silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 40 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches.

The A horizon has value of 2 and chroma of 0 or 1. Typically, it is silty clay, but in some pedons it is silty clay loam. It is neutral or slightly acid. The B horizon has value of 3 or 4 and chroma of 2. It ranges from silty clay in the upper part to silt loam in the lower part. It is neutral or mildly alkaline. The depth to the IIB horizon ranges from 20 to 30 inches. This horizon has value of 4 or 5 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Blend series

The Blend series consists of poorly drained, very slowly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Blend soils are similar to Blencoe and Luton soils and commonly are adjacent to those soils and to Cooper and Woodbury soils. Blencoe and Cooper soils are at the slightly higher elevations. Blencoe soils are medium textured in the lower part of the control section. Cooper soils are moderately fine textured in the upper part. Luton and Woodbury soils are in positions on the landscape similar to those of the Blend soils. Luton soils are fine textured throughout the control section. Woodbury soils are moderately fine textured in the lower part of the control section.

Typical pedon of Blend silty clay, 0 to 2 percent slopes, 350 feet west and 1,000 feet north of the southeast corner of sec. 29, T. 72 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong medium and fine angular blocky structure; firm; medium acid; clear smooth boundary.

A3—10 to 17 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine faint brown (10YR 5/3) mottles; moderate fine and very fine subangular blocky structure; firm; slightly acid; clear smooth boundary.

IIB2—17 to 29 inches; dark grayish brown (10YR 4/2) silty clay loam; some very dark gray (10YR 3/1) peds; common fine distinct strong brown (7.5YR 5/6) mottles; moderate to weak fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

IIIAgb—29 to 33 inches; dark gray (10YR 4/1) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; some filaments of lime on faces of peds; mildly alkaline; gradual smooth boundary.

IIICg—33 to 60 inches; dark gray (10YR 4/1) silty clay; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium and fine subangular blocky structure; firm; few very fine soft lime accumulations; slight effervescence; mildly alkaline.

The thickness of the solum and the depth of carbonates range from 24 to 36 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay or clay. It is medium acid or slightly acid. The depth to the IIB horizon ranges from 12 to 24 inches. This horizon has value of 4 or 5 and chroma of 2 to 4. It is neutral or mildly alkaline. The depth to the III horizon ranges from 24 to 36 inches. This horizon has value of 3 to 6 and chroma of 1 or 2. It is silty clay or clay. It ranges from slightly acid to mildly alkaline. Some pedons do not have a buried horizon.

Bremer series

The Bremer series consists of poorly drained, moderately slowly permeable soils formed in alluvium on stream benches. Slope ranges from 0 to 2 percent.

Bremer soils are similar to Colo and Nevin soils and commonly are adjacent to those soils and to Zook soils. Nevin soils have a lower content of clay than the Bremer soils. They are at the higher elevations. Colo and Zook soils are at the lower elevations. Their mollic epipedon is thicker than that of the Bremer soils.

Typical pedon of Bremer silty clay loam, 0 to 2 percent slopes, 1,500 feet west and 2,250 feet north of the southeast corner of sec. 2, T. 71 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A12—8 to 18 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—18 to 23 inches; very dark gray (N 3/0) silty clay loam; moderate fine prismatic structure parting to moderate very fine subangular blocky; firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

B22t—23 to 36 inches; very dark gray (10YR 3/1) silty clay loam; moderate to weak very fine and fine subangular blocky structure; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B23t—36 to 48 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak very fine subangular blocky structure; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B3t—48 to 55 inches; mixed dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

C—55 to 60 inches; gray (10YR 5/1) silty clay loam; common fine faint yellowish brown (10YR 5/6) and

pale brown (10YR 6/3) mottles; weak very fine subangular blocky structure; friable; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to free carbonates is more than 60 inches. The thickness of the mollic epipedon ranges from 14 to 36 inches.

The A horizon has value of 2 or 3 and chroma of 0 or 1. It is slightly acid or medium acid. The B horizon has value of 3 to 5 and chroma of 0 to 2. It ranges from silty clay loam to silty clay. The C horizon has value of 4 or 5 and chroma of 1.

Buckney series

The Buckney series consists of excessively drained, rapidly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

These soils contain less clay and more sand than is defined as the range for the Buckney series. This difference, however, does not alter the use or behavior of the soils.

Buckney soils commonly are adjacent to Blencoe, Keg, and Salix soils. They are in positions on the landscape similar to those of the adjacent soils. Blencoe soils are fine textured in the upper part of the control section. Keg soils are medium textured throughout the control section. Salix soils are moderately fine textured in the upper part and medium textured in the control section.

Typical pedon of Buckney fine sandy loam, 0 to 2 percent slopes, 2,550 feet east and 800 feet south of the northwest corner of sec. 21, T. 72 N., R. 43 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; single grained; friable; neutral; clear smooth boundary.

A12—7 to 14 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; single grained; loose; neutral; clear smooth boundary.

A13—14 to 22 inches; dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; single grained; loose; slight effervescence; mildly alkaline; gradual smooth boundary.

C1—22 to 36 inches; dark yellowish brown (10YR 4/4) loamy fine sand; single grained; loose; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—36 to 60 inches; grayish brown (10YR 5/2) loamy fine sand; single grained; loose; few thin strata of light brownish gray (10YR 6/2) silt loam; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 24 inches. The depth to carbonates ranges from 30 to 48 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches.

The A horizon has value and chroma of 2 or 3. It is loamy fine sand or fine sandy loam. It is neutral or mildly alkaline. The C horizon has value of 4 to 6 and chroma of 2 to 4. It ranges from loamy fine sand to fine sandy loam. It is mildly alkaline or moderately alkaline.

Calco series

The Calco series consists of poorly drained or very poorly drained, moderately permeable soils formed in alluvium on flood plains. Slope ranges from 0 to 2 percent.

Calco soils are similar to Colo, Nishna, and Zook soils and commonly are adjacent to Colo, Kennebec, and Zook soils. All of the adjacent soils are in positions on the landscape similar to those of the Calco soils. Colo soils do not have carbonates in the solum. Kennebec soils are moderately well drained. They are less clayey than the Calco soils and do not have carbonates in the solum. Nishna soils are fine textured throughout the control section. Zook soils are not calcareous within a depth of 50 inches. They have a fine textured B horizon.

Typical pedon of Calco silty clay loam, 0 to 2 percent slopes, 1,600 feet west and 1,420 feet north of the southeast corner of sec. 29, T. 71 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

A12—9 to 19 inches; black (N 2/0) silty clay loam, black (N 2/0) dry; weak fine subangular blocky structure; friable; few fine fragments of snail shells; strong effervescence; moderately alkaline; gradual smooth boundary.

A13—19 to 26 inches; black (N 2/0) silty clay loam, black (N 2/0) dry; weak coarse blocky structure parting to moderate medium subangular blocky; friable; common fine fragments of snail shells; strong effervescence; moderately alkaline; gradual smooth boundary.

A14—26 to 33 inches; black (5YR 2/1) silty clay loam, dark gray (10YR 4/1) and gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; few fine fragments of snail shells; common soft carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

Bg—33 to 40 inches; very dark gray (10YR 3/1) silty clay loam; weak fine subangular blocky structure; friable; few fine fragments of snail shells; common hard and soft carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg—40 to 60 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam; common medium distinct strong brown (7.5YR 5/6 and 5/8) mottles; massive;

friable; few fine fragments of snail shells; hard and soft carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The thickness of the mollic epipedon ranges from 40 to 50 inches.

The A horizon has value of 2 or 3 and chroma of 0 or 1. It is mildly alkaline or moderately alkaline. The B horizon has value of 3 or 4 and chroma of 0 or 1. The C horizon has value of 3 to 5 and chroma of 0 or 1.

Castana series

The Castana series consists of well drained, moderately permeable soils formed in local alluvium on foot slopes. Slope ranges from 9 to 20 percent.

Castana soils are similar to Napier soils and commonly are adjacent to Hamburg, Ida, and Napier soils. Ida and Hamburg soils are higher on the landscape than the Castana soils. Also, they have a thinner A horizon. Napier soils are not calcareous in the control section. They are less sloping than the Castana soils. Also, they have a thicker A horizon.

Typical pedon of Castana silt loam, 9 to 20 percent slopes, 800 feet north and 900 feet east of the southwest corner of sec. 25, T. 72 N., R. 43 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure parting to weak very fine granular; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

A12—6 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; slight effervescence; moderately alkaline; gradual smooth boundary.

AC—11 to 17 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine granular structure; very friable; few fine calcium accumulations; slight effervescence; moderately alkaline; gradual smooth boundary.

C—17 to 60 inches; brown (10YR 5/3) silt loam; massive; very friable; some lime filaments and calcium accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 24 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 2. It ranges from neutral to moderately alkaline. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Colo series

The Colo series consists of poorly drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Colo soils are similar to Bremer, Calco, Nishna, and Zook soils and commonly are adjacent to Judson, Kennebec, Nodaway, and Zook soils. Bremer soils have a B horizon. Their A1 horizon is thinner than that of the Colo soils. Calco soils are calcareous. Judson soils are on upland fans and in drainageways and are well drained or moderately well drained. They have value of 3 within a depth of 36 inches. Kennebec, Nishna, Nodaway, and Zook soils are in positions on the landscape similar to those of the Colo soils. Kennebec and Nodaway soils are medium textured throughout the control section. Nishna and Zook soils are fine textured in the control section.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, 1,500 feet south and 50 feet east of the northwest corner of sec. 26, T. 72 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; slightly acid; clear smooth boundary.

A12—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; firm; slightly acid; diffuse smooth boundary.

A13—17 to 31 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry, very dark brown (10YR 2/2) crushed; weak fine subangular blocky structure; firm; slightly acid; diffuse smooth boundary.

AC—31 to 43 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry, very dark brown (10YR 2/2) crushed; weak fine subangular blocky structure; firm; slightly acid; diffuse smooth boundary.

C1—43 to 53 inches; very dark gray (10YR 3/1) silty clay loam, very dark grayish brown (10YR 3/2) crushed; weak fine subangular blocky structure; firm; few soft iron oxide accumulations; slightly acid; diffuse smooth boundary.

C2—53 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint dark grayish brown (10YR 4/2) mottles; massive; some vertical cleavage; firm; few soft dark brown iron oxide accumulations; slightly acid.

The thickness of the solum and the thickness of the mollic epipedon range from 36 to 54 inches. The depth to carbonates ranges from 36 to more than 60 inches.

The A horizon has value of 2 or 3 and chroma of 0 or 1. It ranges from neutral to medium acid. It is silty clay loam to silt loam. The C horizon has value of 2 to 4 and chroma of 0 to 2. It is neutral or slightly acid.

Cooper series

The Cooper series consists of somewhat poorly drained soils formed in alluvium on bottom land. Permeability is moderate in the upper part of the profile and slow in the lower part. Slope ranges from 0 to 2 percent.

Cooper soils are similar to Lakeport and Salix soils and commonly are adjacent to Keg, Lakeport, Luton, and Salix soils. Keg soils are medium textured throughout the control section. Lakeport soils are moderately fine textured throughout the control section. Luton soils are fine textured throughout the control section. Salix soils are medium textured in the lower part of the control section. Lakeport and Luton soils are at the lower elevations and Keg and Salix soils at the higher elevations.

Typical pedon of Cooper silty clay loam, 0 to 2 percent slopes, 200 feet west and 1,050 feet south of the northeast corner of sec. 8, T. 72 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—10 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2—17 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine and very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIAb—30 to 45 inches; very dark gray (5Y 3/1) silty clay; few fine distinct dark yellowish brown (10YR 4/4) mottles; strong medium and fine subangular blocky structure; very firm; slight effervescence; moderately alkaline; clear smooth boundary.

IICg—45 to 60 inches; olive gray (5Y 4/2) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; strong medium and fine subangular blocky structure; very firm; many 1/4-inch calcium carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The depth to free carbonates ranges from 20 to 45 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It ranges from slightly acid to mildly alkaline. The B horizon has value of 4 or 5 and chroma of 2 to 4. It generally is silty clay loam but ranges to silt loam. It is neutral or mildly alkaline. The depth to the IIAb horizon ranges from 20 to 30 inches. The IIAb and IIC horizons have value of 3 to 5 and chroma of 1 or 2. They are silty clay or clay. They are mildly alkaline or moderately alkaline.

Corley series

The Corley series consists of poorly drained, moderately permeable soils formed in loess on high stream benches. Slope is 0 to 1 percent.

Corley soils commonly are adjacent to Marshall and Minden soils. The adjacent soils do not have an A2 horizon. They are less mottled in the B horizon than the Corley soils. They are at the slightly higher elevations surrounding the Corley soils.

Typical pedon of Corley silt loam, 0 to 1 percent slopes, 1,750 feet east and 300 feet north of the southwest corner of sec. 34, T. 72 N., R. 41 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; strongly acid; clear smooth boundary.

A12—10 to 18 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; strongly acid; clear smooth boundary.

A2—18 to 29 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 7/1) dry; weak thick platy structure; friable; strongly acid; clear smooth boundary.

B21tg—29 to 36 inches; very dark gray (10YR 3/1) silt loam; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; strongly acid; clear smooth boundary.

B22tg—36 to 47 inches; dark gray (5Y 4/1) silty clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; dark stains along root channels; medium acid; gradual smooth boundary.

B3tg—47 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; dark stains along root channels; slightly acid; gradual smooth boundary.

Cg—60 to 68 inches; olive gray (5Y 5/2) silt loam; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; neutral.

The thickness of the solum ranges from 40 to 60 inches. The A horizon has value of 2 to 4 and chroma of 0 or 1. The B horizon has value of 2 to 5 and chroma of 0 to 2. It ranges from strongly acid to slightly acid. The C horizon has value of 5 or 6 and chroma of 2.

Dow series

The Dow series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 5 to 14 percent.

Dow soils are similar to Ida and Strahan soils and commonly are adjacent to Ida and Marshall soils. The adjacent soils are in positions on the landscape similar to those of the Dow soils. Ida soils are brown and yellowish brown below the A horizon. Marshall soils have a B horizon. They are less gray than the Dow soils and do not have carbonates. Strahan soils are not calcareous in the upper part.

Typical pedon of Dow silt loam, 9 to 14 percent slopes, moderately eroded, 120 feet north and 140 feet west of the southeast corner of sec. 16, T. 72 N., R. 42 W.

Ap—0 to 7 inches; brown (10YR 4/3) and dark brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure parting to weak fine granular; friable; few fine carbonate accumulations; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—7 to 13 inches; yellowish brown (10YR 5/4) and light brownish gray (2.5Y 6/2) silt loam; common fine faint yellowish brown (10YR 5/6) mottles increasing in number with increasing depth; weak medium subangular blocky structure parting to weak fine granular; friable; some calcium carbonate accumulations and filaments on faces of peds; strong effervescence; moderately alkaline; clear smooth boundary.

C2—13 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; few fine distinct reddish brown (5YR 5/4) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; calcium carbonate accumulations increasing in number and size with increasing depth; some lime filaments on cleavage faces; strong effervescence; moderately alkaline.

The A horizon, or the solum, ranges from 4 to 10 inches in thickness. It has value of 2 to 4 and chroma of 2 or 3. It is neutral or mildly alkaline. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Exira series

The Exira series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 5 to 20 percent.

Exira soils are similar to Marshall soils and commonly are adjacent to Adair, Judson, Marshall, and Shelby soils. Adair and Shelby soils formed in glacial till. They are downslope from the Exira soils. Judson soils also are downslope from the Exira soils. They formed in local alluvium. Their mollic epipedon is thicker than that of the Exira soils. Marshall soils are not mottled within a depth of 30 inches. They are in positions on the landscape similar to those of the Exira soils.

Typical pedon of Exira silty clay loam, 5 to 9 percent slopes, 235 feet west and 2,685 feet south of the northeast corner of sec. 24, T. 71 N., R. 41 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—8 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; medium acid; gradual smooth boundary.

B21—11 to 18 inches; brown (10YR 4/3) silty clay loam; dark brown coatings on faces of peds and very dark grayish brown (10YR 3/2) coatings in root channels; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B22—18 to 22 inches; brown (10YR 4/3) silty clay loam; few dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B23—22 to 30 inches; brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (10YR 5/2) and few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine dark manganese concretions; some strong brown (7.5YR 5/6) accumulations of iron oxide; slightly acid; gradual smooth boundary.

B3—30 to 42 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine dark manganese concretions; few fine yellowish red (5YR 4/8) accumulations of iron oxide; slightly acid; gradual smooth boundary.

C—42 to 60 inches; mottled light brownish gray (2.5Y 6/2) and brown (7.5YR 4/4) silt loam; massive; friable; many very fine dark manganese concretions; many yellowish red (5YR 5/8) streaks; neutral.

The thickness of the solum ranges from 30 to 50 inches. The thickness of the mollic epipedon ranges from 10 to 15 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has value of 3 to 6 and chroma of 2 to 4. It is medium acid to neutral. The C horizon has value of 4 to 6 and chroma of 2 to 6.

Grable series

The Grable series consists of well drained or somewhat excessively drained soils formed in alluvium

on bottom land. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 2 percent.

Grable soils are similar to Percival and Haynie soils and commonly are adjacent to Percival, Haynie, Kenmoor, and Sarpy soils. Percival soils have a fine textured surface layer. Haynie soils are medium textured in the lower part of the control section. Kenmoor soils are fine textured in the lower part of the control section. Sarpy soils are coarse textured throughout the control section. Percival and Kenmoor soils are at the lower elevations. Haynie and Sarpy soils are in positions on the landscape similar to those of the Grable soils.

Typical pedon of Grable silt loam, 0 to 2 percent slopes, 1,140 feet west and 500 feet south of the northeast corner of sec. 5, T. 71 N., R. 43 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—8 to 21 inches; stratified dark grayish brown (10YR 4/2) and grayish brown (2.5Y 5/2) silt loam; weak thin to thick platelike structure because of stratification; very friable; few dark iron oxide stains; slight effervescence; moderately alkaline; clear smooth boundary.

IIC2—21 to 60 inches; grayish brown (2.5Y 5/2) fine sand; single grained; loose; slight effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. It is dominantly silt loam but in some pedons is very fine sandy loam. It is neutral or mildly alkaline.

The C1 horizon has value of 4 or 5 and chroma of 2. It is mildly alkaline or moderately alkaline. The depth to the IIC horizon ranges from 20 to 30 inches. This horizon has value of 4 or 5 and chroma of 2. It is mildly alkaline or moderately alkaline. It is dominantly very fine sand or fine sand but ranges from loamy sand to sand.

Hamburg series

The Hamburg series consists of somewhat excessively drained, moderately permeable soils formed in loess on uplands. Slope ranges from 30 to 75 percent.

Hamburg soils are similar to Ida and Strahan soils and commonly are adjacent to Castana, Ida, and Napier soils. Ida and Strahan soils are fine-silty. They are less sloping than the Hamburg soils. Castana and Napier soils are lower on the landscape than the Hamburg soils. Also, they have a thicker A horizon.

Typical pedon of Hamburg silt loam, in an area of Hamburg-Ida silt loams, 30 to 75 percent slopes, 2,540 feet west and 420 feet south of the northeast corner of sec. 4, T. 73 N., R. 43 W.

A1—0 to 4 inches; dark brown (10YR 3/3) coarse silt loam, brown (10YR 5/3) dry; weak very fine granular structure; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—4 to 10 inches; brown (10YR 4/3) coarse silt loam, brown (10YR 5/3) and pale brown (10YR 6/3) dry; weak very fine granular structure; very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—10 to 60 inches; brown (10YR 5/3) coarse silt loam; massive; very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 0 to 12 inches. The A1 horizon has value of 3 or 4 and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. The C horizon has value of 4 to 6 and chroma of 3 or 4. It is mildly alkaline or moderately alkaline.

Haynie series

The Haynie series consists of well drained or moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Haynie soils are similar to Blake, Grable, McPaul, and Modale soils and commonly are adjacent to Grable, Onawa, Percival, and Sarpy soils. Blake soils are finer textured in the upper part of the control section than the Haynie soils. Grable and Percival soils are coarse textured in the lower part of the control section. McPaul soils contain less sand in the control section than the Haynie soils. Modale soils are fine textured in the lower part of the control section. Onawa soils are fine textured in the upper part of the control section. Sarpy soils are coarse textured throughout the control section. Grable and Sarpy soils are in positions on the landscape similar to those of the Haynie soils. Onawa and Percival soils are at the lower elevations.

Typical pedon of Haynie silt loam, 0 to 2 percent slopes, 2,400 feet south and 2,400 feet west of the northeast corner of sec. 13, T. 73 N., R. 44 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (2.5Y 5/2) dry; weak fine subangular blocky and weak fine granular structure; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—8 to 36 inches; brown (10YR 4/3) silt loam; weak fine granular structure; very friable; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—36 to 60 inches; brown (10YR 4/3) very fine sandy loam; few fine faint grayish brown (10YR 5/2) mottles; some horizontal cleavage; very friable; a 4-inch stratum of dark brown (10YR 3/3) silt loam at a depth of 52 inches; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It typically is silt loam, but the range includes very fine sandy loam. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. It is silt loam or very fine sandy loam that has thin strata ranging from fine sandy loam to loamy fine sand.

Ida series

The Ida series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 5 to 30 percent.

Ida soils are similar to Dow, Hamburg, and Strahan soils and commonly are adjacent to those soils and to Castana and Monona soils. Dow, Monona, and Strahan soils are in positions on the landscape similar to those of the Ida soils. Dow soils have a brownish gray or grayish brown control section. Monona soils are not calcareous. They have a mollic epipedon. Strahan soils are not calcareous in the upper part. Hamburg soils contain less clay than the Ida soils. Also, they are steeper. Castana soils are on the lower slopes. They formed in local alluvium.

Typical pedon of Ida silt loam, 20 to 30 percent slopes, 680 feet west and 2,140 feet north of the southeast corner of sec. 4, T. 73 N., R. 43 W.

Ap—0 to 5 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; few carbonate accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

C1—5 to 13 inches; brown (10YR 4/3) silt loam; weak fine granular structure; very friable; few carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—13 to 28 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) silt loam; massive; very friable; many carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—28 to 60 inches; yellowish brown (10YR 5/4) silt loam; common fine faint light brownish gray (10YR 6/2) mottles; massive; very friable; many carbonate accumulations; strong effervescence; moderately alkaline.

The A horizon, or the solum, is less than 10 inches thick. It has value of 3 or 4 and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has value of 4 or 5 and chroma of 3 to 6.

Judson series

The Judson series consists of well drained or moderately well drained, moderately permeable soils formed in local alluvium on foot slopes and alluvial fans. Slope ranges from 2 to 9 percent.

Judson soils are similar to Kennebec and Napier soils and commonly are adjacent to Marshall soils. Kennebec soils typically do not have value of 3 within a depth of 36 inches. Napier soils contain less clay than the Judson soils. Marshall soils are higher on the landscape than the Judson soils. Also, they have a thinner A horizon.

Typical pedon of Judson silty clay loam, 2 to 5 percent slopes, 1,820 feet east and 2,450 feet north of the southwest corner of sec. 24, T. 72 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure parting to weak medium granular; friable; neutral; clear smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; friable; neutral; gradual smooth boundary.

A13—15 to 28 inches; very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

A3—28 to 36 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B2—36 to 47 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 3/3) kneaded; very dark grayish brown (10YR 3/2) coatings on faces of some peds; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B3—47 to 60 inches; brown (10YR 4/3) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to carbonates is more than 60 inches.

The A horizon ranges from 24 to 36 inches in thickness. It has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The B horizon has value and chroma of 3 or 4. It ranges from 27 to 32 percent clay.

Keg series

The Keg series consists of well drained or moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Keg soils are similar to Salix soils and commonly are adjacent to Blencoe, Cooper, Lakeport, and Salix soils. Blencoe soils are fine textured in the upper part of the control section. Cooper soils are fine textured in the lower part of the control section. Lakeport soils are at

the slightly lower elevations. They are finer textured throughout the control section than the Keg soils. Salix soils have a moderately fine textured mollic epipedon. Blencoe, Cooper, and Salix soils are in positions on the landscape similar to those of the Keg soils.

Typical pedon of Keg silt loam, 0 to 2 percent slopes, 100 feet south and 50 feet east of the northwest corner of sec. 34, T. 72 N., R. 43 W.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) crushed; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; abrupt smooth boundary.

A12—6 to 11 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) crushed; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

B2—11 to 22 inches; dark grayish brown (2.5Y 4/2) silt loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

B3—22 to 34 inches; dark grayish brown (2.5Y 4/2) silt loam; few fine faint grayish brown (2.5Y 5/2) mottles; weak fine and very fine subangular blocky structure; friable; mildly alkaline; few very fine calcium carbonate accumulations; gradual smooth boundary.

C—34 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam; a thin stratum of silty clay loam at a depth of about 47 inches; massive; very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches. The depth to free carbonates ranges from 18 to 30 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B2 horizon has value of 4 or 5 and chroma of 2 or 3. It is neutral or mildly alkaline. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. It is dominantly silt loam, but the range includes very fine sandy loam and silty clay loam.

Kenmoor series

The Kenmoor series consists of moderately well drained soils formed in alluvium on bottom land. Permeability is rapid in the upper part of the profile and slow in the lower part. Slope ranges from 0 to 2 percent.

Kenmoor soils are similar to Modale, Moville, and Sarpy soils and commonly are adjacent to Blake, Grable, Modale, and Sarpy soils. Blake soils are moderately fine textured in the upper part of the control section. Grable, Modale, and Moville soils are medium textured in the upper part of the control section. Sarpy soils are coarse textured throughout the control section. Blake and Modale soils are in positions on the landscape similar to those of the Kenmoor soils. Grable and Sarpy soils are at the slightly higher elevations.

Typical pedon of Kenmoor loamy fine sand, 0 to 2 percent slopes, 2,570 feet north and 1,020 feet east of the southwest corner of sec. 1, T. 73 N., R. 44 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; single grained; loose; slight effervescence; mildly alkaline; clear smooth boundary.

C—8 to 24 inches; brown (10YR 4/3) loamy fine sand; single grained; loose; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIAb—24 to 33 inches; very dark grayish brown (10YR 3/2) silty clay; common fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

IIBb—33 to 60 inches; dark grayish brown (10YR 4/2) silty clay; strong very fine subangular blocky structure; firm; few thin strata of silt loam; slight to strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 or 4 and chroma of 2 to 4. The C horizon has value of 4 or 5 and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. The depth to the IIA horizon ranges from 20 to 30 inches. The IIAb and IIBb horizons have value of 2 to 5 and chroma of 2 to 4. They are silty clay or clay. They are mildly alkaline or moderately alkaline.

Kennebec series

The Kennebec series consists of moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Kennebec soils are similar to Judson, Napier, and Nodaway soils and commonly are adjacent to those soils and to Colo soils. Colo soils contain more clay throughout than the Kennebec soils. Judson soils have value of 3 within a depth of 36 inches. Napier soils have a mollic epipedon that is less than 36 inches thick. Nodaway soils do not have a mollic epipedon. Colo and Nodaway soils are in positions on the landscape similar to those of the Kennebec soils. Judson and Napier soils are on foot slopes.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, 150 feet south and 1,780 feet east of the northwest corner of sec. 5, T. 72 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A12—9 to 20 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.
A13—20 to 28 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
AC—28 to 38 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; neutral; gradual smooth boundary.
C1—38 to 49 inches; very dark gray (10YR 3/1) silt loam; weak fine granular structure; friable; neutral; gradual smooth boundary.
C2—49 to 60 inches; very dark grayish brown (10YR 3/2) silt loam; common fine faint dark yellowish brown (10YR 4/4) mottles; weak very fine granular structure; friable; neutral.

The solum and the mollic epipedon are more than 36 inches thick. The depth to free carbonates is more than 60 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The C horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. It typically is silt loam, but the range includes silty clay loam.

Lakeport series

The Lakeport series consists of somewhat poorly drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

These soils have lower chroma in the horizon directly below the mollic epipedon than is defined as the range for the Lakeport series. This difference, however, does not alter the use or behavior of the soils.

Lakeport soils are similar to Blencoe, Cooper, and Salix soils and commonly are adjacent to those soils and to Luton soils. Blencoe soils are fine textured in the upper part of the control section. Cooper soils are fine textured in the lower part of the control section. Luton soils are fine textured throughout the control section. They are in positions on the landscape similar to those of the Lakeport soils or are lower. Salix soils are shallower to the medium textured part of the control section than the Lakeport soils. Blencoe, Cooper, and Salix soils are at the higher elevations.

Typical pedon of Lakeport silty clay loam, 0 to 2 percent slopes, 1,750 feet east and 2,600 feet north of the southwest corner of sec. 16, T. 71 N., R. 43 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.
A12—7 to 14 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; thin layer of dark gray silty clay loam; neutral; gradual smooth boundary.
A3—14 to 19 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; some dark gray (10YR 4/1) stains on faces of peds; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
B21—19 to 29 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine and very fine subangular blocky structure; friable and firm; few sand grains; slight effervescence; mildly alkaline; gradual smooth boundary.
B22—29 to 40 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; firm; slight effervescence; mildly alkaline; gradual smooth boundary.
B3—40 to 46 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; few small carbonate accumulations; strong effervescence; moderately alkaline; clear smooth boundary.
C—46 to 60 inches; light brownish gray (10YR 6/2) coarse silt loam; many fine faint yellowish brown (10YR 5/4) mottles; massive; friable; some carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 48 inches. The depth to carbonate accumulations ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has value of 4 or 5 and chroma of 1 or 2. It ranges from silty clay loam to silty clay. The C horizon is coarse silt loam, loam, clay loam, or very fine sandy loam. It has value of 5 or 6 and chroma of 1 to 4.

Luton series

The Luton series consists of poorly drained or very poorly drained, very slowly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Luton soils are similar to Blencoe, Blend, and Woodbury soils and commonly are adjacent to those soils and to Salix soils. Blencoe and Salix soils are at the higher elevations. Blencoe soils are medium textured in the lower part of the control section. Salix soils are moderately fine textured in the upper part of the control section. Blend and Woodbury soils are on the slightly higher parts of the landscape or in positions similar to those of the Luton soils. Blend soils are medium textured in the middle part of the control section. Woodbury soils

are moderately fine textured in the lower part of the control section.

Typical pedon of Luton silty clay, 0 to 2 percent slopes, 120 feet east and 2,360 feet south of the northwest corner of sec. 2, T. 71 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; neutral; clear smooth boundary.

A12—8 to 14 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A3—14 to 25 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; neutral; clear smooth boundary.

B21—25 to 31 inches; very dark gray (5Y 3/1) silty clay; moderate and strong medium subangular blocky structure; very firm; slight effervescence; mildly alkaline; clear smooth boundary.

B22g—31 to 38 inches; dark gray (5Y 4/1) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; strong medium subangular blocky structure; very firm; few small calcium carbonate accumulations in the lower part; slight effervescence; moderately alkaline; abrupt smooth boundary.

B3g—38 to 44 inches; dark gray (5Y 4/1) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; strong medium subangular blocky structure; very firm; small calcium carbonate accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

Cg—44 to 60 inches; dark gray (5Y 4/1) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; strong fine subangular blocky structure; very firm; small calcium carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 48 inches. The depth to calcium carbonate accumulations ranges from 36 to 46 inches. The thickness of the mollic epipedon ranges from 20 to 32 inches.

The A horizon has value of 2 or 3 and chroma of 0 or 1. It is silty clay or clay. It is neutral or mildly alkaline. The B horizon has value of 3 to 5 and chroma of 1 or 2. It is silty clay or clay. It is neutral to moderately alkaline. The C horizon has value of 4 or 5 and chroma of 1. It is mildly alkaline or moderately alkaline.

Malvern series

The Malvern series consists of moderately well drained or somewhat poorly drained, slowly permeable soils formed in loess on uplands. Slope ranges from 9 to 14 percent.

The dark surface layer in the Malvern soils in this survey area is thinner than is defined as the range for the Malvern series. This difference, however, does not alter the use or behavior of the soils.

Malvern soils are similar to Adair soils and commonly are adjacent to Dow, Judson, Marshall, and Monona soils. Adair soils have a stone line in the upper part of the B horizon and formed in glacial till. The content of sand in their solum is more than 15 percent. Dow soils are medium textured throughout the control section. They are calcareous. They are upslope from the Malvern soils. Judson soils are downslope from the Malvern soils. They are moderately fine textured in the solum. Marshall and Monona soils are in positions on the landscape similar to those of the Malvern soils. They do not have the finer textures or reddish hue characteristic of the Malvern soils.

Typical pedon of Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded, 1,056 feet east and 140 feet south of the northwest corner of sec. 21, T. 71 N., R. 40 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

IIB21—5 to 16 inches; brown (7.5YR 4/4) silty clay; moderate fine subangular blocky structure; friable; few fine faint dark accumulations; neutral; gradual smooth boundary.

IIB22t—16 to 29 inches; mixed brown (7.5YR 4/4) and reddish brown (5YR 4/4) silty clay; few fine distinct light gray (5YR 7/1) and few fine faint strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to strong and moderate fine subangular blocky; very firm; few fine dark accumulations; few very dark gray (10YR 3/1) fillings between peds; thin discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

IIB31t—29 to 45 inches; mixed reddish brown (5YR 4/4) and brown (7.5YR 4/4) silty clay; common fine faint gray (N 6/0) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; few very dark gray (10YR 3/1) fillings between peds; discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

IIB32t—45 to 60 inches; light reddish brown (5YR 6/3) silty clay; common medium distinct strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; moderate and weak medium prismatic structure parting to moderate fine subangular blocky; very firm; common very dark gray (10YR 3/1) fillings between peds; discontinuous clay films on faces of peds; some soft carbonate accumulations at a depth of 56 inches; neutral.

The thickness of the solum ranges from 36 to 60 inches. The depth to carbonate accumulations is 45 inches or more.

The A horizon has value and chroma of 2 or 3. The B horizon has value of 4 to 6 and chroma of 3 to 6. The C horizon has value of 5 or 6 and chroma of 4 to 8.

Marshall series

The Marshall series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 0 to 14 percent.

Marshall soils are similar to Minden, Exira, and Monona soils and are commonly adjacent to Dow, Exira, Judson, Minden, and Monona soils. Dow soils are calcareous. Their solum is thinner than that of the Marshall soils. Exira soils are shallower to mottles than the Marshall soils. Judson soils formed in local alluvium. They are lower on the landscape than the Marshall soils. Also, their mollic epipedon is thicker. The somewhat poorly drained Minden soils commonly have lower chroma in the upper part of the B horizon than the Marshall soils. Also, their A horizon is somewhat thicker. Monona soils are medium textured throughout the control section. They typically are somewhat less acid than the Marshall soils. Dow, Exira, Minden, and Monona soils are in positions on the landscape similar to those of the Marshall soils.

Typical pedon of Marshall silty clay loam, 2 to 5 percent slopes, 50 feet south and 2,020 feet east of the northwest corner of sec. 12, T. 71 N., R. 40 W.

Ap—0 to 7 inches; black (10YR 2/1) and very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry, very dark brown (10YR 2/2) kneaded; weak medium subangular blocky structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.

A12—7 to 12 inches; black (10YR 2/1) and very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry, very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) kneaded; moderate medium and fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A3—12 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry, dark brown (10YR 3/3) kneaded; moderate medium and fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B21—17 to 24 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) coatings on faces of peds; moderate fine subangular blocky structure; friable; few very dark brown (10YR 2/2) peds; slightly acid; gradual smooth boundary.

B22t—24 to 32 inches; brown (10YR 4/3) silty clay loam; moderate fine and very fine subangular blocky structure; thin discontinuous clay films on some peds; few very dark brown (10YR 2/2) peds; friable; slightly acid; gradual smooth boundary.

B31t—32 to 38 inches; brown (10YR 4/3) and yellowish brown (10YR 5/4) silty clay loam; common fine faint grayish brown (10 YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few thin discontinuous clay films; few dark accumulations; slightly acid; gradual smooth boundary.

B32—38 to 45 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few dark accumulations; neutral; gradual smooth boundary.

B33—45 to 53 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silty clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; clay films on vertical faces of peds; neutral; gradual smooth boundary.

C—53 to 64 inches; mottled yellowish brown (10YR 5/4 and 5/6) and grayish brown (10YR 5/2) silt loam; massive; friable; few dark accumulations; neutral.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 17 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has value of 3 to 5 and chroma of 2 to 4. It is slightly acid or neutral. The C horizon has value of 4 or 5 and chroma of 2 to 6.

McPaul series

The McPaul series consists of well drained or moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

McPaul soils are similar to Haynie, Modale, Moville, and Rawles soils and commonly are adjacent to Castana, Kennebec, Moville, Napier, and Rawles soils. Haynie soils contain more sand in the control section than the McPaul soils. Kennebec, Castana, and Napier soils have a mollic epipedon. Modale and Moville soils are fine textured in the lower part of the control section. Rawles soils are medium textured in the lower part of the control section. Castana and Napier soils are on the higher parts of the landscape. Kennebec, Moville, and Rawles soils are in positions on the landscape similar to those of the McPaul soils.

Typical pedon of McPaul silt loam, 0 to 2 percent slopes, 200 feet south and 100 feet east of the northwest corner of sec. 2, T. 71 N., R. 43 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—8 to 60 inches; stratified dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam;

common fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; weak thin platy structure; very friable; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. The C horizon has value of 4 or 5 and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Minden series

The Minden series consists of somewhat poorly drained, moderately permeable soils formed in loess on high benches along streams. Slope ranges from 0 to 2 percent.

Minden soils are similar to Marshall soils and commonly are adjacent to Corley and Marshall soils. Corley soils have an A2 horizon. They are in the slightly lower depressions. Marshall soils are well drained. They are in positions on the landscape similar to those of the Minden soils. Their B horizon typically has higher chroma than that of the Minden soils.

Typical pedon of Minden silty clay loam, 0 to 2 percent slopes, 1,700 feet east and 300 feet south of the northwest corner of sec. 8, T. 72 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

A12—8 to 16 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.

A3—16 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 4/3) dry; weak very fine subangular blocky structure parting to moderate fine and medium granular; friable; medium acid; gradual smooth boundary.

B21—21 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine dark accumulations; medium acid; gradual smooth boundary.

B22—31 to 37 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few dark accumulations; medium acid; gradual smooth boundary.

B3—37 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common dark accumulations; medium acid; gradual smooth boundary.

C—43 to 60 inches; grayish brown (2.5Y 5/2) silt loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; medium acid.

The thickness of the solum ranges from 40 to 70 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is medium acid or slightly acid.

Modale series

The Modale series consists of moderately well drained or somewhat poorly drained soils formed in alluvium on bottom land. Permeability is moderate in the upper part of the profile and very slow or slow in the lower part. Slope ranges from 0 to 2 percent.

Modale soils are similar to Haynie, Kenmoor, McPaul, and Moville soils and commonly are adjacent to Albaton, Grable, Haynie, and Kenmoor soils. Albaton soils are fine textured throughout the control section. They are on the lower parts of the landscape. Grable and Haynie soils are on the higher parts of the landscape. Grable soils are coarse textured in the lower part of the control section. Haynie and McPaul soils are medium textured throughout the control section. Kenmoor soils are moderately coarse textured in the upper part of the control section. They are in positions on the landscape similar to those of the Modale soils. Moville soils are dark in the upper part of a fine textured buried horizon. They generally contain less sand in the upper part of the control section than the Modale soils.

Typical pedon of Modale silt loam, 0 to 2 percent slopes, 160 feet west and 400 feet south of the northeast corner of sec. 7, T. 71 N., R. 43 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 28 inches; stratified grayish brown (10YR 5/2) and brown (10YR 5/3) silt loam; moderate fine subangular blocky structure; some horizontal cleavage; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIC2—28 to 60 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine and medium angular blocky structure; very firm; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is silt loam or very fine sandy loam. It is mildly alkaline or moderately alkaline. The depth to the IIC horizon ranges from 18 to 30 inches. This horizon has value of 3 to 5 and chroma

of 0 to 2. It is clay or silty clay. It is mildly alkaline or moderately alkaline.

Monona series

The Monona series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 2 to 30 percent.

Monona soils are similar to Marshall soils and commonly are adjacent to Marshall, Dow, Ida, and Napier soils. Dow, Ida, and Marshall soils are in positions on the landscape similar to those of the Monona soils. Marshall soils contain more clay than the Monona soils. Dow and Ida soils are calcareous closer to the surface than the Monona soils. Also, their solum is thinner. Napier soils are lower on the landscape than the Monona soils. Also, their mollic epipedon is thicker.

Typical pedon of Monona silt loam, 2 to 5 percent slopes, 1,460 feet east and 200 feet south of the northwest corner of sec. 13, T. 73 N., R. 43 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky and weak fine granular structure; friable; neutral; clear smooth boundary.

A12—8 to 15 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak very fine subangular blocky and weak very fine granular structure; friable; neutral; clear smooth boundary.

B1—15 to 28 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B2—28 to 35 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

C—35 to 60 inches; brown (10YR 4/3) silt loam; common fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles that increase in size and abundance with increasing depth; massive; very friable; few fine soft dark accumulations; neutral.

The thickness of the solum ranges from 24 to 42 inches. The depth to carbonates ranges from 24 to 72 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has value of 4 or 5 and chroma of 3 or 4. The C horizon has value of 4 or 5 and chroma of 3 to 6. It is neutral to moderately alkaline.

Moville series

The Moville series consists of somewhat poorly drained soils formed in alluvium on bottom land. Permeability is moderate in the upper part of the profile and very slow in the lower part. Slope ranges from 0 to 2 percent.

Moville soils are similar to Kenmoor, McPaul, and Modale soils and commonly are adjacent to Luton and McPaul soils. Kenmoor and Modale soils do not have a thick, dark horizon in the lower part of the control section. McPaul soils are medium textured throughout the control section. They are in positions on the landscape similar to those of the Moville soils. Luton soils have a mollic epipedon and are fine textured throughout the control section. They are on the lower parts of the landscape.

Typical pedon of Moville silt loam, 0 to 2 percent slopes, 1,630 feet south and 160 feet east of the northwest corner of sec. 2, T. 71 N., R. 43 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak coarse subangular blocky structure parting to moderate very fine granular; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C—7 to 25 inches; stratified dark grayish brown (10YR 4/2), gray (10YR 5/1), grayish brown (10YR 5/2), and very dark gray (10YR 3/1) silt loam; few fine distinct yellowish red (5YR 4/6) and strong brown (7.5YR 5/8) mottles, common in the lower 6 inches; weak horizontal cleavage; very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIA11b—25 to 32 inches; black (10YR 2/1) silty clay; strong fine and very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

IIA12b—32 to 41 inches; black (10YR 2/1) silty clay; strong fine and very fine subangular blocky structure; some vertical cleavage; firm; neutral; gradual smooth boundary.

IIA3gb—41 to 48 inches; very dark gray (N 3/0) and olive gray (5Y 4/2) silty clay; strong fine and very fine subangular blocky structure; some vertical cleavage; firm; some clay films on faces of peds; neutral; gradual smooth boundary.

IIB2gb—48 to 55 inches; dark gray (5Y 4/1) silty clay; strong fine subangular blocky structure; some vertical cleavage; very firm; some clay films on vertical faces of peds; neutral; gradual smooth boundary.

IIB3gb—55 to 60 inches; dark gray (5Y 4/1) silty clay; massive; vertical cleavage; very firm; clay films on vertical faces of peds; slight effervescence; few carbonate accumulations; mildly alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 or 4 and chroma of 2. The C horizon has value of 3 to 6 and chroma of 1 to 3. It is mildly alkaline or moderately alkaline.

The depth to the IIA1 horizon ranges from 18 to 30 inches. This horizon has value of 2 or 3 and chroma of 0

or 1. It is silty clay or clay. It is neutral or mildly alkaline. The IIB horizon has value of 4 to 6 and chroma of 1 or less. It is silty clay or clay. It is neutral or mildly alkaline.

Napier series

The Napier series consists of well drained, moderately permeable soils formed in local alluvium on foot slopes near the larger streams and in narrow drainageways. Slope ranges from 2 to 9 percent.

Napier soils are similar to Castana, Judson, and Kennebec soils and commonly are adjacent to Castana, Ida, Kennebec, and Monona soils. Castana, Ida, and Monona soils are higher on the landscape than the Napier soils and generally are more sloping. Also, Castana soils are calcareous. Judson soils are finer textured than the Napier soils. Kennebec soils are darker than the Napier soils. Also, they are at lower elevations.

Typical pedon of Napier silt loam, 2 to 5 percent slopes, 2,450 feet west and 740 feet north of the southeast corner of sec. 25, T. 71 N., R. 43 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine and very fine granular structure; friable; many roots and pores; neutral; gradual smooth boundary.

A12—7 to 17 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate very fine subangular blocky and very fine granular structure; friable; many roots and pores; neutral; gradual smooth boundary.

A13—17 to 30 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B1—30 to 40 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B2—40 to 54 inches; brown (10YR 4/3) silt loam; moderate fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B3—54 to 60 inches; brown (10YR 4/3) silt loam; moderate fine and very fine subangular blocky structure; friable; mildly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 40 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The B and C horizons are neutral or mildly alkaline. The B horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 3 or 4.

Nevin series

The Nevin series consists of somewhat poorly drained, moderately permeable soils formed in alluvium on stream benches. Slope ranges from 0 to 2 percent.

Nevin soils are similar to Bremer soils and commonly are adjacent to those soils. The adjacent soils are poorly drained and are on the lower parts of the landscape. They contain more clay than the Nevin soils.

Typical pedon of Nevin silty clay loam, 0 to 2 percent slopes, 870 feet east and 230 feet south of the northwest corner of sec. 11, T. 71 N., R. 41 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; slightly acid; clear smooth boundary.

A12—7 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; gradual smooth boundary.

A13—12 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A3—18 to 28 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B1t—28 to 32 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on faces of peds; weak very fine subangular blocky structure; friable; few thin discontinuous clay films; slightly acid; gradual smooth boundary.

B21t—32 to 37 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on faces of peds; weak fine prismatic structure parting to weak very fine subangular blocky; firm; few thin discontinuous clay films; few fine black accumulations; neutral; gradual smooth boundary.

B22—37 to 43 inches; brown (10YR 5/3) silty clay loam; few fine faint yellowish brown (10YR 5/6 and 5/8) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; firm; few fine black accumulations; neutral; gradual smooth boundary.

B3—43 to 48 inches; brown (10YR 5/3) silty clay loam; few fine faint yellowish brown (10YR 5/6 and 5/8) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine black accumulations; neutral; gradual smooth boundary.

C—48 to 60 inches; brown (10YR 5/3) silt loam; common fine faint yellowish brown (10YR 5/6) mottles; massive; some vertical cleavage; friable; few fine black accumulations; neutral.

The thickness of the solum ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 18 to 30 inches.

The A horizon has value of 2 or 3 and chroma of 1. It is silty clay loam or silt loam. It is medium acid to neutral. The B horizon has value of 4 or 5 and chroma of 2 or 3. It is slightly acid or neutral. The C horizon has value of 4 or 5 and chroma of 3. It is silt loam or silty clay loam.

Nishna series

The Nishna series consists of poorly drained, slowly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Nishna soils are similar to Calco, Colo, and Zook soils and commonly are adjacent to those soils. They are in positions on the landscape similar to those of the adjacent soils. Calco soils contain less clay than the Nishna soils. Colo and Zook soils are not calcareous in the surface layer.

Typical pedon of Nishna silty clay loam, 0 to 2 percent slopes, 105 feet north and 800 feet east of the southwest corner of sec. 15, T. 71 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (7.5YR 4/0) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; slight effervescence; mildly alkaline; clear smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (7.5YR 4/0) dry; moderate fine subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

A13—15 to 24 inches; black (10YR 2/1) silty clay, dark gray (7.5YR 4/0) dry; moderate fine subangular blocky structure; firm; gray lime flecks and small carbonate accumulations; slight effervescence; moderately alkaline; gradual smooth boundary.

Bg—24 to 32 inches; very dark gray (10YR 3/1) silty clay; moderate fine subangular blocky structure; firm; some soft and hard carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg—32 to 60 inches; dark gray (10YR 4/1) silty clay; common fine faint brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; firm; many soft and hard carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 40 inches. The thickness of the mollic epipedon ranges from 24 to 36 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has value of 2 and chroma of 0 or 1. It is silty clay loam or silty clay. The Bg horizon has value of 3 and chroma of 0 or 1. The C horizon has value of 3 or 4 and chroma of 0 or 1.

Nodaway series

The Nodaway series consists of moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Nodaway soils are similar to Ackmore and Rawles soils and commonly are adjacent to Ackmore, Colo, and Kennebec soils. They are in positions on the landscape similar to those of the adjacent soils. Ackmore and Rawles soils have a buried horizon at a depth of 20 to 36 inches. Colo and Kennebec soils have a thick, dark A horizon.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, 580 feet south and 70 feet west of the northeast corner of sec. 16, T. 71 N., R. 41 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.

C—8 to 60 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam; few fine yellowish brown (10YR 5/4 and 5/8) stains; massive; friable; few thin strata of finer and coarser textured material; neutral.

The solum and the mollic epipedon are 5 to 10 inches thick. The A and C horizons are neutral or slightly acid. The A horizon has value of 3 to 5 and chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 2 to 4.

Onawa series

The Onawa series consists of somewhat poorly drained or poorly drained soils formed in alluvium on bottom land. Permeability is slow in the upper part of the profile and moderate or moderately rapid in the lower part. Slope ranges from 0 to 2 percent.

Onawa soils are similar to Albaton, Blake, and Percival soils and commonly are adjacent to those soils and to Vore soils. Albaton soils are at the slightly lower elevations. They are fine textured throughout the control section. Blake, Percival, and Vore soils are in positions on the landscape similar to those of the Onawa soils. Blake and Vore soils have a moderately fine textured surface layer. Percival soils typically are underlain by fine sand.

Typical pedon of Onawa silty clay, 0 to 2 percent slopes, 2,350 feet east and 225 feet north of the southwest corner of sec. 30, T. 72 N., R. 43 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak very fine subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C1g—7 to 28 inches; dark grayish brown (10YR 4/2) silty clay; moderate very fine and fine subangular

blocky structure in some strata and massive in others; firm; few fine faint brown (10YR 4/3) mottles, mostly in root channels; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—28 to 60 inches; stratified grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; some horizontal cleavage; very friable; few thin strata of very fine sandy loam; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. The C1g horizon has value of 4 or 5 and chroma of 2 or less. It is silty clay or clay. It is mildly alkaline or moderately alkaline. The depth to the IIC horizon ranges from 18 to 30 inches. This horizon has value of 4 to 6 and chroma of 2 or less. It is mildly alkaline or moderately alkaline. It is dominantly silt loam, but the range includes loam and very fine sandy loam.

Percival series

The Percival series consists of somewhat poorly drained soils formed in alluvium on bottom land. Permeability is slow in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 2 percent.

Percival soils are similar to Albaton, Grable, Onawa, and Vore soils and commonly are adjacent to those soils. Albaton soils are at the slightly lower elevations. They are fine textured throughout the control section. Grable soils are medium textured in the upper part of the control section. They are at the higher elevations. Onawa soils are at elevations similar to those of the Percival soils. They are medium textured in the lower part of the control section. Vore soils are at elevations similar to those of the Percival soils. They are moderately fine textured in the upper part of the control section.

Typical pedon of Percival silty clay, 0 to 2 percent slopes, 200 feet east and 1,500 feet south of the northwest corner of sec. 19, T. 73 N., R. 43 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C1g—7 to 20 inches; dark gray (5Y 4/1) silty clay; weak very fine subangular blocky structure in some strata and massive in others; firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—20 to 60 inches; grayish brown (2.5Y 5/2) fine sand; common fine faint dark yellowish brown (10 YR 4/4) mottles; single grained; loose; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. The C1g horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay or clay. It is mildly alkaline or moderately alkaline. The depth to the IIC horizon ranges from 15 to 23 inches. This horizon has value of 5 or 6 and chroma of 2. It is mildly alkaline or moderately alkaline. It generally is fine sand or loamy fine sand but in some pedons has thin strata of other textures.

Percival silty clay, dark surface, 0 to 2 percent slopes, is a taxadjunct to the Percival series because the surface layer is darker and thicker than is defined as the range for the series. This difference, however, does not alter the use or behavior of the soil.

Rawles series

The Rawles series consists of moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Rawles soils are similar to Ackmore, McPaul, and Nodaway soils and commonly are adjacent to Kennebec, McPaul, Nodaway, and Colo soils. They are in positions on the landscape similar to those of the adjacent soils. Kennebec and Colo soils have a mollic epipedon. McPaul and Nodaway soils do not have a dark buried A horizon. The dark buried A horizon of Moville and Ackmore soils is finer textured than that of the Rawles soils.

Typical pedon of Rawles silt loam, 0 to 2 percent slopes, 500 feet west and 75 feet north of the southeast corner of sec. 31, T. 73 N., R. 42 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C—8 to 26 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam; few fine faint yellowish brown (10YR 5/4) mottles; massive; very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

IIA11b—26 to 35 inches; black (10YR 2/1) silt loam; weak very fine subangular blocky structure parting to weak fine granular; friable; slight effervescence; mildly alkaline; gradual smooth boundary.

IIA12b—35 to 44 inches; black (10YR 2/1) silt loam; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; gradual smooth boundary.

IIA13b—44 to 60 inches; very dark brown (10YR 2/2) silt loam; weak fine and very fine subangular blocky structure; friable; neutral.

The A horizon, or the solum, is 6 to 10 inches thick. The Ap and C horizons are mildly alkaline or moderately alkaline. The C horizon has value of 3 to 5 and chroma of 2 or 3. The depth to the IIA horizon ranges from 20 to

36 inches. This horizon is silt loam or silty clay loam. It is mildly alkaline to slightly acid. It has value of 2 or 3 and chroma of 1 or 2.

Salix series

The Salix series consists of moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Salix soils are similar to Cooper, Keg, and Lakeport soils and commonly are adjacent to those soils and to Blencoe and Luton soils. Blencoe, Cooper, and Keg soils are in positions on the landscape similar to those of the Salix soils. Blencoe soils are fine textured in the upper part of the control section. Cooper soils are fine textured in the lower part of the control section. Keg soils are medium textured throughout the control section. Lakeport soils are deeper to the medium textured part of the control section than the Salix soils. They are on the slightly lower parts of the landscape. Luton soils are fine textured throughout the control section. They are on the lower parts of the landscape.

Typical pedon of Salix silty clay loam, 0 to 2 percent slopes, 2,580 feet west and 1,100 feet north of the southeast corner of sec. 33, T. 71 N., R. 43 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—7 to 13 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2—13 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate fine subangular blocky structure parting to moderate fine granular; friable; neutral; gradual smooth boundary.

B3—20 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure parting to moderate fine granular; friable; neutral; clear smooth boundary.

C1—27 to 40 inches; brown (10YR 4/3) coarse silt loam; common fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; few fine carbonate accumulations; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—40 to 60 inches; brown (10YR 5/3) coarse silt loam; common fine faint yellowish brown (10YR 5/4) mottles; massive; very friable; few fine carbonate accumulations; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 36 inches. The depth to carbonate accumulations ranges from 24 to 36 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam or silt loam. It is slightly acid to mildly alkaline. The B horizon has value of 3 to 5 and chroma of 2 or 3. It is slightly acid to mildly alkaline. The C horizon has value of 4 or 5 and chroma of 2 or 3. It is coarse silt loam or very fine sandy loam. It is mildly alkaline or moderately alkaline.

Sarpy series

The Sarpy series consists of excessively drained, rapidly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 3 percent.

Sarpy soils are similar to Kenmoor soils and commonly are adjacent to Grable, Haynie, Kenmoor, and Percival soils. Grable and Haynie soils are in positions on the landscape similar to those of the Sarpy soils. Grable soils are medium textured in the upper part of the control section. Haynie soils are medium textured throughout the control section. Kenmoor and Percival soils are on the lower parts of the landscape. Kenmoor soils are fine textured in the lower part of the control section. Percival soils are fine textured in the upper part of the control section.

Typical pedon of Sarpy fine sandy loam, 0 to 2 percent slopes, 2,590 feet east and 70 feet south of the northwest corner of sec. 31, T. 73 N., R. 43 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; single grained; loose; slight effervescence; mildly alkaline; clear smooth boundary.

C1—7 to 24 inches; grayish brown (2.5Y 5/2) fine sand; single grained; loose; strong effervescence; moderately alkaline; diffuse smooth boundary.

C2—24 to 60 inches; grayish brown (10YR 5/2) fine sand; single grained; loose; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 to 5 and chroma of 1 to 3. It is loamy fine sand or fine sandy loam. It is mildly alkaline or moderately alkaline. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is loamy fine sand or fine sand. It is mildly alkaline or moderately alkaline.

Shelby series

The Shelby series consists of moderately well drained or well drained, moderately slowly permeable soils formed in glacial till on uplands. Slope ranges from 9 to 18 percent.

These soils do not have an argillic horizon, which is definitive for the Shelby series. This difference, however, does not alter the use or behavior of the soils.

Shelby soils are similar to Adair soils and commonly are adjacent to Adair, Marshall, and Steinauer soils. Adair soils contain more clay than the Shelby soils and

have redder mottles. Also, they are higher on the landscape. Marshall soils contain less clay than the Shelby soils. They formed entirely in loess. They are on the higher slopes. Steinauer soils are calcareous. They are in positions on the landscape similar to those of the Shelby soils.

Typical pedon of Shelby clay loam, 9 to 14 percent slopes, moderately eroded, 2,410 feet west and 920 feet south of the northeast corner of sec. 25, T. 72 N., R. 40 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) clay loam, dark grayish brown (10YR 4/2) dry, very dark brown (10YR 2/2) kneaded; weak very fine subangular blocky structure parting to weak fine granular; friable; medium acid; clear smooth boundary.

A3—7 to 14 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) and brown (10YR 4/3) dry; some very dark gray (10YR 3/1) worm casts; moderate fine granular structure; friable; medium acid; clear smooth boundary.

B21t—14 to 20 inches; dark brown (10YR 3/3) clay loam; very dark gray (10YR 3/1) faces on some peds; moderate very fine subangular blocky structure; friable; thin continuous clay films; few small pebbles; medium acid; clear smooth boundary.

B22t—20 to 28 inches; dark yellowish brown (10YR 4/4) clay loam; moderate very fine subangular blocky structure; friable; thin continuous clay films; few small pebbles; medium acid; gradual smooth boundary.

B3t—28 to 42 inches; brown (10YR 4/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; weak medium blocky structure; firm; thin discontinuous clay films; many small pebbles; medium acid; gradual smooth boundary.

C—42 to 60 inches; mottled grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) clay loam; massive; firm; few fine dark accumulations; some sand grains and small pebbles; neutral.

The thickness of the solum ranges from 40 to 50 inches. The depth to free carbonates ranges from 36 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 18 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is clay loam, loam, or silt loam. It ranges from strongly acid to slightly acid. The B2t horizon has value of 3 to 5 and chroma of 3, 4, or 6. It is medium acid or strongly acid. The C horizon has value of 4 or 5 and chroma of 2 to 6. It ranges from neutral to moderately alkaline.

Steinauer series

The Steinauer series consists of well drained, moderately slowly permeable soils formed in glacial till on uplands. Slope ranges from 11 to 18 percent.

Steinauer soils commonly are adjacent to Shelby and Marshall soils. Marshall soils formed entirely in loess. They are on the higher parts of the landscape. Shelby soils are leached to a greater depth than the Steinauer soils. They are in positions on the landscape similar to those of the Steinauer soils.

Typical pedon of Steinauer clay loam, 11 to 18 percent slopes, 1,230 feet west and 1,670 feet south of the northeast corner of sec. 11, T. 71 N., R. 41 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium granular structure; friable; few fine carbonate accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

AC—7 to 13 inches; yellowish brown (10YR 5/4) clay loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; friable; some organic stains on faces of peds; few fine carbonate accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

C1—13 to 32 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/8) and few fine faint light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few small pebbles; some carbonate accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/8) and common fine faint light brownish gray (10YR 6/2) mottles; weak medium prismatic structure; firm; many small pebbles; hard and soft carbonate accumulations; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 8 to 21 inches. Carbonate accumulations are near the surface or as much as 14 inches from the surface.

The A horizon has value of 4 to 6 and chroma of 2. It is mildly alkaline or moderately alkaline. The AC horizon has value of 4 or 5 and chroma of 1, 2, or 4. It is mildly alkaline or moderately alkaline. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is loam or clay loam.

Strahan series

The Strahan series consists of well drained, moderately permeable soils formed in loess on uplands. Slope ranges from 5 to 14 percent.

Strahan soils are similar to Dow, Ida, and Hamburg soils and commonly are adjacent to Dow, Ida, Monona, and Marshall soils. They are in positions on the landscape similar to those of the adjacent soils. Dow soils are calcareous. Ida and Hamburg soils are brown and yellowish brown below the A horizon. They are calcareous. Marshall and Monona soils do not have carbonates. Their B horizon is less gray than that of the Strahan soils.

Typical pedon of Strahan silt loam, 5 to 9 percent slopes, moderately eroded, 522 feet east and 1,528 feet south of the northwest corner of sec. 18, T. 71 N., R. 40 W.

Ap—0 to 7 inches; mixed brown (10YR 4/3) and very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) and pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

C1—7 to 18 inches; mixed brown (10YR 4/3) and grayish brown (10YR 5/2) silt loam; many fine faint yellowish brown (10YR 5/6) mottles; massive; very friable; neutral; gradual smooth boundary.

C2—18 to 39 inches; grayish brown (10YR 5/2) silt loam; common medium and coarse faint yellowish brown (10YR 5/6 and 5/8) mottles; massive; very friable; neutral; gradual smooth boundary.

C3—39 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silt loam; massive; friable; few soft iron accumulations; few dark stains; few soft calcium carbonate accumulations; slight effervescence; mildly alkaline.

The A horizon, or the solum, is 4 to 10 inches thick. It has value of 3 or 4 and chroma of 2 or 3. It is neutral or mildly alkaline. The C horizon has value of 4 to 6 and chroma of 2 to 6. It is neutral or mildly alkaline.

Vore series

The Vore series consists of moderately well drained soils formed in alluvium on bottom land. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 2 percent.

Vore soils are similar to Blake and Percival soils and commonly are adjacent to Albaton, Blake, Kenmoor, and Percival soils. Albaton soils are at the slightly lower elevations. They are fine textured. Blake, Kenmoor, and Percival soils are in positions on the landscape similar to those of the Vore soils. Blake soils are medium textured in the lower part of the control section. Kenmoor soils are fine textured in the lower part of the control section. Percival soils are fine textured in the upper part of the control section.

Typical pedon of Vore silty clay loam, 0 to 2 percent slopes, 1,000 feet east and 290 feet north of the southwest corner of sec. 13, T. 73 N., R. 44 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—7 to 16 inches; stratified dark grayish brown (2.5Y 4/2) and grayish brown (10YR 5/2) silty clay loam; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—16 to 60 inches; grayish brown (2.5Y 5/2) fine sand; weak thick platy structure; loose; strong effervescence; moderately alkaline.

The A horizon, or the solum, is 6 to 10 inches thick. It has value of 3 or 4 and chroma of 1 or 2. It is silty clay loam, silt loam, or loam. The C1 and IIC horizons are mildly alkaline or moderately alkaline. The C1 horizon has value of 4 to 6 and chroma of 2 to 4. The IIC horizon has value of 4 to 6 and chroma of 2 to 4. It is fine sand or loamy fine sand.

Woodbury series

The Woodbury series consists of poorly drained or somewhat poorly drained soils formed in alluvium on bottom land. Permeability is slow in the upper part of the profile and moderate or moderately slow in the lower part. Slope ranges from 0 to 2 percent.

Woodbury soils are similar to Blencoe and Luton soils and commonly are adjacent to Blencoe, Cooper, Lakeport, and Luton soils. Blencoe and Cooper soils are on the slightly higher parts of the landscape. Blencoe soils are medium textured in the lower part of the control section. Cooper soils are fine textured in the lower part of the control section. Lakeport and Luton soils are in positions on the landscape similar to those of the Woodbury soils. Lakeport soils are moderately fine textured in the upper part of the control section. Luton soils are fine textured throughout the control section.

Typical pedon of Woodbury silty clay, 0 to 2 percent slopes, 2,600 feet south and 2,000 feet west of the northeast corner of sec. 28, T. 71 N., R. 43 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; cloddy; firm; slightly acid; abrupt smooth boundary.

A12—9 to 13 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong fine subangular blocky structure; firm; slightly acid; clear smooth boundary.

A3—13 to 23 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; strong fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

B21—23 to 27 inches; very dark grayish brown (2.5Y 3/2) silty clay; very dark gray (10YR 3/1) coatings

on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; sheen on some peds; slightly acid; gradual smooth boundary.

B22g—27 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay; gray (5Y 5/1) coatings on faces of peds; few fine faint brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few dark accumulations; slightly acid; gradual smooth boundary.

B3—34 to 41 inches; dark grayish brown (10YR 4/2) silty clay loam; gray (5Y 5/1) coatings on faces of peds; few fine faint dark yellowish brown (10YR 4/4) mottles; strong very fine subangular blocky structure; friable and firm; slightly acid; clear smooth boundary.

C—41 to 60 inches; mottled grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) silt loam; weak fine subangular blocky structure; friable; few fine dark accumulations; neutral; slight effervescence at a depth of 48 inches.

The thickness of the solum and the depth to free carbonates range from 36 to 48 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1. It is silty clay or clay. It is slightly acid or neutral. The B horizon has value of 3 or 4 and chroma of 1 or 2. It is silty clay or silty clay loam. It is slightly acid or neutral. The C horizon has value of 4 or 5 and chroma of 2 or 4. It ranges from silty clay loam to silt loam. It is neutral or mildly alkaline.

Zook series

The Zook series consists of poorly drained, slowly permeable soils formed in alluvium on bottom land. Slope ranges from 0 to 2 percent.

Zook soils are similar to Calco, Colo, and Nishna soils and commonly are adjacent to those soils and to Ackmore, Bremer, and Nodaway soils. Ackmore soils have a buried A horizon. They are medium textured in the upper part of the control section. Bremer, Calco, and Colo soils are moderately fine textured throughout the control section. Nishna soils are calcareous. Nodaway soils are medium textured throughout the control section. Bremer soils are on the slightly higher parts of the landscape. Ackmore, Calco, Colo, Nishna, and Nodaway soils are in positions on the landscape similar to those of the Zook soils.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, 2,700 feet west and 2,180 feet north of the southeast corner of sec. 7, T. 72 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.

A12—9 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A3—17 to 30 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; sheen on faces of peds; neutral; gradual smooth boundary.

Bg—30 to 54 inches; very dark gray (10YR 3/1) silty clay; moderate medium subangular blocky structure; very firm; sheen on faces of peds; neutral; gradual smooth boundary.

Cg—54 to 65 inches; dark gray (10YR 4/1) silty clay; few fine distinct yellowish brown (10YR 5/6) mottles; massive; vertical cleavage; firm; few fine dark concretions; neutral.

The thickness of the solum ranges from 36 to 60 inches. The depth to carbonate accumulations is 50 inches or more. The thickness of the mollic epipedon ranges from 30 to 55 inches.

The A horizon has value of 2 or 3 and chroma of 1. It is slightly acid or neutral. The B and C horizons have value of 3 to 5 and chroma of 1.

formation of the soils

The following paragraphs describe the factors that have affected the formation of the soils in Mills County. Also described are the processes of soil formation.

factors of soil formation

Soils form through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate during and after the accumulation of the soil material, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material. Human activities also affect soil formation.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

parent material

The soils of Mills County formed in loess, alluvium, and glacial till. Cretaceous limestone and shale are exposed at the base of the bluffs south of Glenwood, but they have had little or no effect on the soils in this area.

Alluvium is the most extensive parent material in the county. It is the parent material of 38 different soils in the county, which make up about half of the total

Figure 13.—An area of the gently sloping Judson soils below an area of strongly sloping Marshall soils on side slopes. Judson soils formed in local alluvium and Marshall soils in loess.

Figure 14.—Thick layer of loess in a limestone quarry.

acreage. It is sediment deposited by water along the major streams and along narrow upland drainageways. The alluvium ranges from sand to clay because of differences among the material from which it came and the manner in which it was deposited. More than half of the soils that formed in alluvium are in a large area along the Missouri River, in areas along the West Nishnabotna River, and in small areas along upland streams and drainageways.

Some alluvial material, called local alluvium, has been transported only a short distance. Such alluvium retains many characteristics of the soils in the areas from which it eroded. Judson and Napier soils, for example, generally are at the base of slopes and are lower on the landscape than the soils that formed in loess (fig. 13). Castana soils formed partly in colluvium, which moved downslope by the action of gravity. All of the soils at the base of slopes are similar in texture to the soils upslope.

The alluvial soils are in two broad groups. One group formed in alluvium that has been in place long enough for soil-forming factors to have had an effect on the soils. Examples are Luton, Blencoe, Colo, Keg, Salix, Lakeport, and Cooper soils. The second group formed in recent alluvium. Examples are Sarpy, Haynie, McPaul, Onawa, Blake, and Albaton soils. Because of the accumulation of organic matter, the first group is darker in the upper part than the second group and is dark to a greater depth.

The texture of the soils that formed in alluvium varies widely. Luton and Albaton soils formed entirely in clayey alluvium. Sarpy soils are loamy and sandy throughout. Keg, Haynie, McPaul, and Kennebec soils are dominantly silt loam throughout. Colo and Lakeport soils are dominantly silty clay loam throughout. Some alluvial soils have layers of different textures. Examples are Blencoe, Blake, Blend, Onawa, Modale, and Percival soils. Nevin

soils are dominantly silty clay loam throughout. They are on low stream benches or second bottoms along the West Nishnabotna River. They are not subject to flooding. They have a profile that is more strongly expressed than that of alluvial soils on first bottoms, which are subject to flooding.

Loess is the second most extensive parent material in the county. It is yellowish brown, wind deposited material that consists largely of silt particles and smaller amounts of clay and sand (fig. 14). Most of the upland soils formed in Wisconsin Loess. Ida, Monona, and Marshall soils are the most extensive of these soils. Hamburg soils are on bluffs adjacent to the valley of the Missouri River. The wind probably carried most of the Wisconsin Loess from the flood plain along the Missouri River to the uplands during the Wisconsin glacial period, about 25,000 to 14,000 years ago (*10*). The thickness of the loess and the differences among the soils that formed in it are related to the distance from the Missouri River (*6, 10*). The loess is as much as about 100 feet thick on the bluffs in the northwestern part of the county (fig. 15). In the southeastern part, it thins out to about 30 feet. In some areas, mainly on steep hillsides adjacent to stream valleys, it has been removed by geologic erosion. In these areas glacial till or Loveland Loess is exposed.

The loess in the southwestern and southern parts of Iowa thins out and becomes finer textured than that in the eastern part (*6, 10*). A marked change in texture is evident in Mills County. Marshall soils, which are in the eastern part of the county, are higher in content of clay than Hamburg soils, which are in the western part.

Figure 15.—Vertical road cut through loess.

The older Loveland Loess is exposed in places on side slopes. It was deposited during the Illinoian glacial episode (*10, 11*). A reddish paleosol formed in this loess during the Sangamon interglacial period. It was subsequently covered by the Wisconsin Loess. Malvern soils formed in areas where the paleosol was exposed by geologic erosion. The loess in western Iowa has been analyzed in a number of studies (*3, 4, 5, 6, 12, 13, 17*).

Glacial till is the parent material of only a few soils in the county. Thick glacial till deposits are throughout the uplands, but most are covered by loess. The till is exposed mainly on upland hillsides near the West Nishnabotna River, where the loess has been removed by erosion.

Most of the glacial till was probably deposited during the Kansan Glaciation. A few exposures may be from the earlier Nebraskan Glaciation. The unweathered till is a heterogeneous mixture. It is firm, calcareous clay loam that contains pebbles, boulders, and sand as well as silt and clay. It shows little evidence of sorting or stratification. The mineral composition also is heterogeneous and is similar to that of particles in unweathered loess.

Some soils formed on the Kansan till plain during the Yarmouth and Sangamon Interglacial Stages before the loess was deposited. They are called Yarmouth-Sangamon paleosols. The nearly level soils on this plain are strongly weathered and have a gray, plastic subsoil called gumbotil (*11*). The gumbotil is several feet thick and very slowly permeable. It is not exposed in Mills County.

A widespread erosion surface has cut below the Yarmouth-Sangamon paleosol into Kansan Till and older deposits. It generally is characterized by a stone line or subjacent sediment and is surmounted by pedisediment. A paleosol formed in the pedisediment, stone line, and generally subjacent till. This surface is of Late Sangamon age. The paleosols are less strongly weathered, more reddish, and not so thick as those in the nearly level areas. Adair soils are an example.

The soils that formed in the Kansan Till during the Yarmouth and Sangamon period were covered by loess. Geologic erosion has removed the loess from some slopes and has exposed the paleosol. In other areas erosion has removed all of the paleosol and has exposed till that is only slightly weathered at the surface. Shelby and Steinauer soils formed in this till.

plant and animal life

Several kinds of living organisms affect soil formation. Burrowing animals, worms, crayfish, and micro-organisms, for example, influence soils properties. Differences in the kind of vegetation, however, commonly cause the most marked differences among soils.

Tall grasses were the dominant vegetation at the time when Mills County was settled. Trees grew in some areas, mainly in steep areas within a few miles of the valley of the Missouri River and in areas along streams. The thickest stands were on the north- and east-facing slopes.

Because grasses have many roots and tops that decay, soils that formed on prairies typically have a thicker, darker surface layer than the soils that formed under trees. The organic matter in the soils that formed under trees is derived principally from fallen leaves. These soils generally are more acid than the soils that formed under grasses. Marshall and Monona soils are typical prairie soils. The stands of trees on these soils have not been in place long enough to affect soil formation significantly.

climate

The soils in Mills County formed under a variety of climatic conditions. About 13,000 to 10,500 years ago, the climate in central Iowa was cool and the vegetation was dominantly conifers (*16*). During the period beginning about 10,500 years ago and ending about 8,000 years ago, a warming trend changed the vegetation from conifers to mixed hardwoods. Beginning about 8,000 years ago, the climate became warmer and drier and herbaceous prairie vegetation became dominant. Probably about 3,000 years ago, a change from a dry to a more moist climate began (*9*). The soils in the county formed under the influence of this midcontinental, subhumid climate.

Because it is nearly uniform throughout the county, the climate has not resulted in major differences among the soils. The effect of the climate, however, is modified by local conditions in or near the soil. For example, most of the water received by the very steep Hamburg soils on bluffs runs off or rapidly penetrates the surface. As a result, the microclimate is warmer and drier than is typical in the nearby areas. It also is warmer and drier on south-facing slopes than on north- and east-facing slopes. As a result, natural stands of trees are more likely to grow well on the north- and east-facing slopes. The poorly drained or very poorly drained soils in low lying areas or depressions are wetter and cooler than the soils in most of the surrounding areas.

Changes in the temperature activate the weathering of parent material by water and air. As the parent material weathers, changes caused by physical and chemical actions take place. Rainfall affects the amount of leaching in the soil and the kinds of plants on the soil. Temperature and other climatic factors indirectly affect soil formation through their effect on the plant and animal life on and in the soil.

relief

Relief, is an important factor in soil formation because of its effect on drainage, runoff, depth to the water table, and erosion. Slope ranges from nearly level to very

steep in Mills County. A difference in relief is the main reason for the differing properties among some of the soils in the county.

The influence of relief is evident in the color, the thickness of the solum, and the development of horizons. For example, Ida and Monona soils formed in similar parent material but have different characteristics, mainly because of relief. Some of the water received by the well drained Monona soils runs off the surface. The more sloping Ida soils are in positions on the landscape where water runs off so rapidly and erosion occurs at such a rapid rate that little soil formation takes place. As a result, the surface layer of the Monona soils is thicker and darker than that of the Ida soils. Monona soils are leached of carbonates, but Ida soils are calcareous at or near the surface.

Slope affects the thickness of the solum and the depth to carbonates. In Monona, Shelby, and other soils that have a wide range in slope, for example, the depth to carbonates and the thickness of the solum decrease as the slope increases and as the surface becomes more convex.

Relief affects the color of the B horizon through its effect on drainage and soil aeration. In soils that are well drained, the subsoil generally is brown because iron compounds are well distributed throughout the horizon and are oxidized. In soils where drainage is restricted, however, the subsoil is grayish and mottled. For example, the poorly drained or very poorly drained Luton soils on the bottom land along the Missouri River have a gray and olive gray subsoil. In contrast, the well drained Keg soils at the slightly higher elevations have a brownish subsoil.

time

Time enables relief, climate, and plant and animal life to change the parent material. If these factors continue to operate for a long period, similar kinds of soil form in widely different kinds of parent material. Soil formation, however, generally is interrupted by geologic events that expose new parent material.

In Mills County, the bedrock was covered by glacial drift from two glaciers, the Nebraskan and the Kansan. Later, the Loveland Loess was deposited, and then the Wisconsin Loess.

Adair soils have the most weathered subsoil in the county (*11*). They formed in Kansan till, which began to weather in the late Sangamon period and then was covered by loess. More recently, the upper part of this ancient subsoil was exposed to weathering again when the loess was removed by erosion.

About 90 percent of the soils in Mills County are less than 14,000 years old. According to radiocarbon dates, loess deposition began about 25,000 years ago and continued to about 14,000 years ago. Based on these dates, the surface of the nearly level, loess-mantled divides in Iowa is about 14,000 years old. In much of Iowa, including Mills County, geologic erosion has beveled and in places removed material on side slopes and deposited new sediments downslope (*11*). The soil material on the surface of the nearly level upland divides is older than that on the slopes that truncate the divides. Thus, the soils on these side slopes are less than 14,000 years old.

The sediments stripped from the side slopes accumulated downslope as local alluvium. The age of soil material on the side slopes can be determined by dating the alluvial fill at the base of the slopes. Studies by Daniels and Jordan indicate that the alluvium in some stream valleys in western Iowa is less than 1,800 years old (*3*). Studies of Adair County, in southwest Iowa, indicate that the base of the alluvial fill is about 6,800 years old (*11*). The soil material on the surface of the side slopes is as young as or younger than these dates. Judson, Napier, Kennebec, and other soils formed in similar alluvium.

Some of the soils on the bottom land along the Missouri River formed in alluvium that has been deposited since settlement. Other soils, such as Salix and Keg soils, are older. They have not been flooded since before they were plowed by the first settlers. The difference in the time that the soil-forming factors have been active is reflected in the characteristics of the soils.

human activities

Important changes take place in the soil after it is drained and cultivated. Changes caused by water erosion generally are the most significant. On many of the cultivated soils in the county, much of the surface layer has been lost through erosion, and in some places gullies have formed. Tilling the surface layer alters the structure of the soil. Less obvious are the chemical changes brought about by applications of lime and fertilizer and the changes in microbial activity and organic matter content that result from removing the native vegetation and growing crops.

Human activities have strongly affected the formation of McPaul and Moville soils on bottom land (fig. 16). These originally dark soils have been covered by a new parent material, which is light colored and calcareous. This material eroded from the uplands, largely because of farming.

processes of soil formation

Horizon differentiation is caused by at least four processes. These processes are additions, removals, transfers, and transformations. Each of these processes affects many substances that make up a soil. Examples are the addition, removal, transfer, or transformation of organic matter, soluble salts, carbonates, sesquioxides, or silicate clay minerals.

Generally, these processes promote horizon differentiation, but some tend to retard it. These

Figure 16.—A cultivated area of McPaul silt loam, 0 to 2 percent slopes, on bottom land along the Missouri River.

processes and the changes they bring about proceed simultaneously in soils. The ultimate nature of the profile is governed by the balance of those changes within the profile.

In Mills County the soils on flood plains are divided into two broad groups, based mainly on the additions of organic matter. The soils that have a thick, dark surface layer are separated from those that do not. The dark color, or lack of it, is the most obvious difference between the Luton and Albaton soils, between the Keg and Haynie soils, and between the Blencoe and Onawa soils. In some soils on uplands, the dark surface layer is the only soil feature that reflects the processes of soil formation. Examples are Ida and Steinauer soils.

The removal of substances from parts of the soil profile accounts for some of the most obvious differences among soils in the county. An example is the downward movement of calcium carbonates that results from leaching. In Ida, Steinauer, and other soils, little calcium carbonate has been removed. These soils are calcareous at or near the surface. In many areas lime concretions are on the surface. No B horizon has formed in these soils. In contrast, leaching has removed calcium carbonates from the upper part of Monona and Shelby soils. This removal, along with other processes, has resulted in the differentiation of a B horizon.

The transfer of substances from one horizon to another is evident in the soils of Mills County. Phosphorus, removed from the subsoil by plant roots, is transferred to parts of the plant growing above the ground. Then, it is added to the surface layer in the plant residue.

The translocation of silicate clay minerals helps to differentiate horizons. Clay minerals from the A horizon are carried downward in suspension in percolating water. They accumulate in the B horizon in pores and root channels and as clay films on the faces of peds. Corley and Adair are the only soils in Mills County markedly affected by this process. In other soils, the content of clay in the A horizon is not markedly different from that in the B horizon and other evidence of clay movement is minimal.

Another kind of transfer in some of the very clayey soils is caused by the formation of cracks brought about by shrinking and swelling. Because of the cracks, some of the material from the surface layer is incorporated into lower parts of the profile. Examples are Luton and Albaton soils.

Transformations are physical and chemical processes. For example, soil particles weather to smaller sizes. The reduction of iron, a process called gleying, is common in

poorly drained or very poorly drained soils, such as Luton soils. These soils are saturated for long periods. Their grayish colors are evidence of gleying. Another kind of transformation is the weathering of a primary apatite mineral, present in parent material, to a secondary phosphorus compound. Apparently, the pH level must decline to about 7 before much of this weathering can take place. The differences in the supply of available phosphorus among soils that formed in similar calcareous parent material are explained by this process. For example, Ida soils are calcareous and have a very low supply of available phosphorus. In contrast, Monona soils, which have been leached and are about neutral, have a higher supply of available phosphorus.

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glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the

surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of

the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdividions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-73 at Glenwood, Iowa]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	31.1	11.4	21.2	60	-17	0	.79	.27	1.20	2	6.7
February---	38.6	18.2	28.3	68	-12	0	1.04	.32	1.61	3	7.2
March------	48.1	26.8	37.5	83	-3	64	1.97	.52	3.12	5	7.2
April------	64.5	39.8	52.2	90	19	139	2.92	1.50	4.07	6	.7
May--------	74.9	50.7	62.8	93	30	403	4.64	2.67	6.23	7	.3
June-------	83.9	60.8	72.4	100	43	672	4.57	2.19	6.50	7	.0
July-------	87.6	64.4	75.9	100	48	803	3.81	1.67	5.54	6	.0
August-----	86.0	62.8	74.4	99	46	756	4.58	2.13	6.58	7	.0
September--	77.7	53.6	65.7	96	33	471	4.06	1.62	6.02	6	.0
October----	68.3	42.7	55.6	89	21	223	2.25	.63	3.54	4	.1
November---	50.6	29.0	39.8	75	5	15	1.26	.24	2.06	3	2.5
December---	36.5	17.2	26.8	63	-13	0	1.12	.29	1.77	3	7.1
Yearly:											
Average--	62.3	39.8	51.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	101	-19	---	---	---	---	---	---
Total----	---	---	---	---	---	3,546	33.01	25.56	39.11	59	31.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-73 at Glenwood, Iowa]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 19	April 28	May 12
2 years in 10 later than--	April 15	April 23	May 6
5 years in 10 later than--	April 6	April 13	April 26
First freezing temperature in fall:			
1 year in 10 earlier than--	October 17	October 7	September 23
2 years in 10 earlier than--	October 22	October 12	September 29
5 years in 10 earlier than--	October 31	October 22	October 9

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-73 at Glenwood, Iowa]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	187	168	141
8 years in 10	194	176	149
5 years in 10	207	190	165
2 years in 10	220	205	180
1 year in 10	226	213	189

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1C	Ida silt loam, 5 to 9 percent slopes	385	0.1
1C3	Ida silt loam, 5 to 9 percent slopes, severely eroded	720	0.3
1D	Ida silt loam, 9 to 14 percent slopes	3,040	1.1
1D3	Ida silt loam, 9 to 14 percent slopes, severely eroded	4,720	1.7
1E	Ida silt loam, 14 to 20 percent slopes	2,185	0.8
1E3	Ida silt loam, 14 to 20 percent slopes, severely eroded	8,490	3.0
1F	Ida silt loam, 20 to 30 percent slopes	2,630	0.9
1F3	Ida silt loam, 20 to 30 percent slopes, severely eroded	3,020	1.1
2G	Hamburg-Ida silt loams, 30 to 75 percent slopes	3,370	1.2
3E	Castana silt loam, 9 to 20 percent slopes	205	0.1
8B	Judson silty clay loam, 2 to 5 percent slopes	15,360	5.4
8C	Judson silty clay loam, 5 to 9 percent slopes	290	0.1
9	Marshall silty clay loam, 0 to 2 percent slopes	1,685	0.6
9B	Marshall silty clay loam, 2 to 5 percent slopes	26,100	9.2
9C	Marshall silty clay loam, 5 to 9 percent slopes	4,490	1.6
9C2	Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded	7,270	2.5
9D	Marshall silty clay loam, 9 to 14 percent slopes	2,455	0.9
9D2	Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded	5,845	2.0
9D3	Marshall silty clay loam, 9 to 14 percent slopes, severely eroded	235	0.1
10B	Monona silt loam, 2 to 5 percent slopes	3,360	1.2
10C	Monona silt loam, 5 to 9 percent slopes	2,510	0.9
10C2	Monona silt loam, 5 to 9 percent slopes, moderately eroded	11,780	4.1
10D	Monona silt loam, 9 to 14 percent slopes	1,550	0.5
10D2	Monona silt loam, 9 to 14 percent slopes, moderately eroded	17,940	6.3
10D3	Monona silt loam, 9 to 14 percent slopes, severely eroded	1,665	0.6
10E	Monona silt loam, 14 to 20 percent slopes	520	0.2
10E2	Monona silt loam, 14 to 20 percent slopes, moderately eroded	2,675	0.9
10E3	Monona silt loam, 14 to 20 percent slopes, severely eroded	405	0.1
10F2	Monona silt loam, 20 to 30 percent slopes, moderately eroded	455	0.2
11B	Colo-Judson silty clay loams, 2 to 5 percent slopes	5,445	1.9
12B	Napier silt loam, 2 to 5 percent slopes	21,680	7.6
12C	Napier silt loam, 5 to 9 percent slopes	1,530	0.5
22C2	Dow silt loam, 5 to 9 percent slopes, moderately eroded	205	0.1
22D2	Dow silt loam, 9 to 14 percent slopes, moderately eroded	1,365	0.5
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded	815	0.3
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded	210	0.1
33D	Steinauer clay loam, 11 to 18 percent slopes	330	0.1
36	Salix silty clay loam, 0 to 2 percent slopes	2,585	0.9
43	Bremer silty clay loam, 0 to 2 percent slopes	2,165	0.8
44	Blencoe silty clay, 0 to 2 percent slopes	1,085	0.4
46	Keg silt loam, 0 to 2 percent slopes	2,815	1.0
54	Zook silty clay loam, 0 to 2 percent slopes	4,235	1.5
54+	Zook silt loam, overwash, 0 to 2 percent slopes	670	0.2
60D2	Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded	935	0.3
66	Luton silty clay, 0 to 2 percent slopes	1,780	0.6
66+	Luton silt loam, overwash, 0 to 2 percent slopes	345	0.1
67	Woodbury silty clay, 0 to 2 percent slopes	225	0.1
70	McPaul silt loam, 0 to 2 percent slopes	3,145	1.1
88	Nevin silty clay loam, 0 to 2 percent slopes	1,715	0.6
93D2	Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded	560	0.2
99C	Exira silty clay loam, 5 to 9 percent slopes	1,705	0.6
99C2	Exira silty clay loam, 5 to 9 percent slopes, moderately eroded	3,020	1.1
99D	Exira silty clay loam, 9 to 14 percent slopes	2,020	0.7
99D2	Exira silty clay loam, 9 to 14 percent slopes, moderately eroded	17,625	6.2
99D3	Exira silty clay loam, 9 to 14 percent slopes, severely eroded	870	0.3
99E2	Exira silty clay loam, 14 to 20 percent slopes, moderately eroded	180	0.1
112C2	Strahan silt loam, 5 to 9 percent slopes, moderately eroded	275	0.1
112D2	Strahan silt loam, 9 to 14 percent slopes, moderately eroded	660	0.2
133	Colo silty clay loam, 0 to 2 percent slopes	4,990	1.7
133+	Colo silt loam, overwash, 0 to 2 percent slopes	1,645	0.6
137	Haynie silt loam, 0 to 2 percent slopes	4,380	1.5
144	Blake silty clay loam, 0 to 2 percent slopes	3,535	1.2
146	Onawa silty clay, 0 to 2 percent slopes	3,695	1.3
149	Modale silt loam, 0 to 2 percent slopes	1,215	0.4
156	Albaton silty clay, 0 to 2 percent slopes	4,355	1.5
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	860	0.3
212	Kennebec silt loam, 0 to 2 percent slopes	6,555	2.3
212+	Kennebec silt loam, overwash, 0 to 2 percent slopes	2,135	0.7
220	Nodaway silt loam, 0 to 2 percent slopes	8,000	2.8
234	Nishna silty clay loam, 0 to 2 percent slopes	1,280	0.4
237	Sarpy loamy fine sand, 1 to 3 percent slopes	1,015	0.4
238	Sarpy fine sandy loam, 0 to 2 percent slopes	865	0.3

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
244	Blend silty clay, 0 to 2 percent slopes	465	0.2
255	Cooper silty clay loam, 0 to 2 percent slopes	1,240	0.4
275	Moville silt loam, 0 to 2 percent slopes	910	0.3
430	Ackmore silt loam, 0 to 2 percent slopes	925	0.3
436	Lakeport silty clay loam, 0 to 2 percent slopes	1,560	0.5
509	Marshall silty clay loam, benches, 0 to 2 percent slopes	2,615	0.9
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes	1,545	0.5
509C	Marshall silty clay loam, benches, 5 to 9 percent slopes	250	0.1
509C2	Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	570	0.2
510B	Monona silt loam, benches, 2 to 5 percent slopes	290	0.1
514	Grable silt loam, 0 to 2 percent slopes	2,115	0.7
515	Percival silty clay, 0 to 2 percent slopes	1,230	0.4
516	Vore silty clay loam, 0 to 2 percent slopes	1,505	0.5
555	Percival silty clay, dark surface, 0 to 2 percent slopes	320	0.1
636	Buckney fine sandy loam, 0 to 2 percent slopes	195	0.1
670	Rawles silt loam, 0 to 2 percent slopes	710	0.2
717	Napier-Gullied land complex, 2 to 10 percent slopes	3,465	1.2
733	Calco silty clay loam, 0 to 2 percent slopes	630	0.2
849	Kenmoor loamy fine sand, 0 to 2 percent slopes	370	0.1
1233	Corley silt loam, 0 to 1 percent slopes	200	0.1
1299	Minden silty clay loam, 0 to 2 percent slopes	1,420	0.5
5030	Pits and dumps, quarry	200	0.1
5040	Orthents, loamy	315	0.1
	Water	2,640	0.9
	Total	285,760	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
1C---------- Ida	83	32	58	3.1	5.0	3.3	5.1
1C3---------- Ida	77	29	54	2.9	4.7	2.7	4.8
1D---------- Ida	74	28	52	2.8	4.5	2.7	4.6
1D3---------- Ida	68	26	48	2.6	4.0	2.3	4.3
1E---------- Ida	59	22	41	2.3	3.5	1.6	3.8
1E3---------- Ida	54	20	37	2.1	3.0	1.3	3.5
1F---------- Ida	---	---	---	1.7	2.8	1.3	2.8
1F3---------- Ida	---	---	---	1.5	2.8	1.2	2.5
2G. Hamburg-Ida							
3E---------- Castana	64	24	49	2.4	3.8	2.3	4.0
8B---------- Judson	124	47	93	5.2	7.3	4.2	8.6
8C---------- Judson	119	45	90	5.0	7.1	4.1	8.3
9---------- Marshall	109	41	62	4.6	6.5	3.8	7.6
9B---------- Marshall	107	41	61	4.5	6.3	3.8	7.5
9C---------- Marshall	102	39	58	4.3	6.1	3.5	7.1
9C2---------- Marshall	99	38	56	4.2	5.9	3.3	7.0
9D---------- Marshall	93	35	53	3.9	5.5	3.3	6.5
9D2---------- Marshall	90	34	51	3.8	5.3	3.0	6.3
9D3---------- Marshall	84	32	48	3.5	4.8	3.0	5.8
10B---------- Monona	98	37	69	4.1	5.8	3.7	6.8
10C---------- Monona	92	35	64	3.8	5.4	3.7	6.4

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
10C2---- Monona	90	34	63	3.8	5.3	3.7	6.3
10D---- Monona	83	31	58	3.4	4.8	3.3	5.6
10D2---- Monona	81	31	57	3.4	4.8	3.3	5.6
10D3---- Monona	75	28	53	2.9	4.5	2.7	4.8
10E, 10E2---- Monona	69	26	47	2.8	4.2	2.6	4.7
10E3---- Monona	66	25	46	2.7	4.0	2.5	4.5
10F2---- Monona	---	---	---	2.2	3.2	1.8	3.6
11B---- Colo-Judson	113	43	85	4.6	6.3	4.2	7.8
12B---- Napier	105	40	74	4.4	6.3	3.8	7.3
12C---- Napier	100	38	70	4.2	6.0	3.8	7.0
22C2---- Dow	76	29	53	2.9	4.6	2.7	4.8
22D2---- Dow	67	25	46	2.5	4.0	2.3	4.2
24D2---- Shelby	81	31	44	3.4	4.9	3.3	5.6
24E2---- Shelby	66	25	36	2.7	4.0	2.1	4.5
33D---- Steinauer	76	29	43	2.9	4.8	2.6	4.0
36**---- Salix	114	43	80	4.3	6.8	4.2	7.6
43---- Bremer	106	40	58	4.5	6.3	4.0	7.5
44**---- Blencoe	96	36	67	3.6	5.0	3.7	6.0
46**---- Keg	118	45	83	4.5	7.0	4.2	7.5
54---- Zook	96	36	72	4.0	4.0	4.0	7.0
54+---- Zook	101	38	75	4.2	4.4	4.4	7.3
60D2---- Malvern	71	27	41	3.0	4.2	3.2	5.0
66**---- Luton	68	26	48	2.6	4.1	2.5	4.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
66+---- Luton	75	29	53	2.9	4.4	2.6	4.8
67**---- Woodbury	80	30	56	3.3	4.8	3.3	5.5
70**---- McPaul	98	37	69	3.7	5.8	3.7	6.1
88---- Nevin	114	43	63	4.8	8.0	4.0	8.0
93D2---- Shelby-Adair	69	26	38	2.9	4.0	2.7	4.8
99C---- Exira	102	39	58	3.9	6.5	3.5	5.8
99C2---- Exira	99	39	56	3.8	6.3	3.3	5.6
99D---- Exira	93	35	53	3.5	5.8	3.3	5.5
99D2---- Exira	90	34	51	3.4	5.5	3.0	4.9
99D3---- Exira	84	32	48	3.2	5.0	3.0	4.8
99E2---- Exira	75	28	42	2.8	4.8	2.8	4.4
112C2, 112D2---- Strahan	82	31	53	3.1	4.9	3.3	5.6
133---- Colo	104	40	78	4.2	5.5	4.2	7.0
133+---- Colo	109	42	82	4.3	5.8	4.2	7.0
137**---- Haynie	96	36	67	3.6	5.7	3.7	6.0
144**---- Blake	98	37	69	3.9	5.2	3.7	6.5
146---- Onawa	90	34	63	3.4	5.3	3.7	5.6
149**---- Modale	92	35	64	3.9	5.5	3.7	6.5
156---- Albaton	80	30	56	3.1	4.0	3.3	5.1
192D2---- Adair	54	20	30	2.3	2.9	1.9	3.8
212---- Kennebec	100	38	75	4.5	6.5	3.8	7.5
212+---- Kennebec	95	36	72	4.3	6.2	3.8	7.1
220---- Nodaway	106	39	76	4.1	5.5	4.0	6.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
234---------- Nishna	90	35	41	3.6	5.3	3.7	6.0
237, 238---------- Sarpy	53	19	25	1.7	2.5	1.6	2.1
244**---------- Blend	80	30	56	3.0	4.0	3.3	5.0
255**---------- Cooper	98	37	69	3.7	5.8	3.7	6.1
275**---------- Moville	98	37	69	3.7	5.5	3.7	6.1
430---------- Ackmore	106	40	58	4.5	6.3	3.8	7.5
436**---------- Lakeport	105	40	74	4.0	6.3	3.7	6.6
509---------- Marshall	109	41	62	4.6	6.5	3.8	7.6
509B---------- Marshall	107	41	61	4.5	6.3	3.8	7.5
509C---------- Marshall	102	39	58	4.3	6.1	3.5	7.1
509C2---------- Marshall	99	38	56	4.2	5.9	3.3	7.0
510B---------- Monona	98	37	69	4.1	5.8	3.7	6.8
514**---------- Grable	75	28	52	3.2	4.5	2.7	5.3
515**---------- Percival	65	25	45	2.6	3.8	2.3	4.3
516**---------- Vore	75	28	53	3.2	4.5	2.7	5.3
555**---------- Percival	70	27	50	3.0	4.2	2.5	4.5
636---------- Buckney	62	24	30	2.4	3.2	2.1	3.6
670---------- Rawles	84	32	59	3.2	5.1	3.9	5.4
717---------- Napier-Gullied land	---	---	---	---	---	0.8	---
733---------- Calco	99	38	84	4.2	5.3	4.2	7.0
849---------- Kenmoor	60	22	26	2.2	3.1	2.0	3.4
1233---------- Corley	91	35	52	3.6	5.5	3.7	6.0
1299---------- Minden	115	44	66	4.4	6.8	4.3	7.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
5030***. Pits and dumps							
5040***. Orthents							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** Yields are for areas protected from flooding.
*** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	35,360	---	---	---
II	110,050	68,335	38,095	3,620
III	104,820	95,805	8,450	565
IV	19,435	17,555	---	1,880
V	---	---	---	---
VI	6,105	6,105	---	---
VII	6,835	6,835	---	---
VIII	---	---	---	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1C, 1C3, 1D, 1D3, 1E, 1E3, 1F, 1F3--Ida	---	Tatarian honeysuckle, Siberian peashrub.	Green ash, osageorange, nannyberry viburnum, eastern redcedar, northern white-cedar.	---	---
2G*:					
Hamburg	---	Tatarian honeysuckle, Siberian peashrub.	Green ash, osageorange, eastern redcedar, northern white-cedar.	---	---
Ida	---	Siberian peashrub, Tatarian honeysuckle.	Green ash, nannyberry viburnum, eastern redcedar, osageorange, northern white-cedar.	---	---
3E--Castana	---	Tatarian honeysuckle, Siberian peashrub, lilac.	Russian-olive, nannyberry viburnum, eastern redcedar, northern white-cedar.	Green ash, common hackberry.	---
8B, 8C--Judson	Silky dogwood, gray dogwood.	Tatarian honeysuckle, redosier dogwood, Siberian peashrub.	Amur maple, eastern redcedar.	Common hackberry, eastern white pine, Norway spruce.	Eastern cottonwood, silver maple.
9, 9B, 9C, 9C2, 9D, 9D2, 9D3--Marshall	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Norway spruce, common hackberry, green ash.	Eastern white pine, silver maple.
10B, 10C, 10C2, 10D, 10D2, 10D3, 10E, 10E2, 10E3--Monona	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, Siberian dogwood.	Amur maple, eastern redcedar.	Norway spruce, common hackberry, green ash.	Eastern white pine, silver maple.
10F2. Monona					
11B*:					
Colo	Redosier dogwood, silky dogwood.	Siberian dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Eastern redcedar, white spruce, Amur maple, northern white-cedar.	Green ash	Silver maple, eastern cottonwood.
Judson	Silky dogwood, gray dogwood.	Tatarian honeysuckle, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
12B, 12C---------- Napier	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Norway spruce, common hackberry, green ash.	Eastern cottonwood, silver maple.
22C2, 22D2-------- Dow	---	Lilac, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, nannyberry viburnum, northern white-cedar.	Green ash, common hackberry.	---
24D2, 24E2-------- Shelby	Silky dogwood, gray dogwood.	Tatarian honeysuckle, lilac, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce, green ash.	Eastern white pine, silver maple.
33D---------- Steinauer	Skunkbush sumac, Peking cotoneaster, Tatarian honeysuckle.	Russian-olive-----	Eastern redcedar, ponderosa pine, Austrian pine, bur oak, Scotch pine, honeylocust, osageorange.	---	---
36---------- Salix	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
43---------- Bremer	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Eastern redcedar, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
44---------- Blencoe	Redosier dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, Siberian peashrub, American plum.	Amur maple, northern white-cedar, Russian-olive.	Green ash, common hackberry.	Eastern cottonwood.
46---------- Keg	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
54, 54+---------- Zook	Silky dogwood, redosier dogwood.	Siberian dogwood, Tatarian honeysuckle, Zabel honeysuckle, bloodtwig dogwood.	Northern white-cedar, Amur maple.	Green ash---------	Silver maple, eastern cottonwood.
60D2---------- Malvern	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
66, 66+---------- Luton	Common ninebark---	Silky dogwood, redosier dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar.	Golden willow, green ash.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
67---------- Woodbury	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash----------	Silver maple, eastern cottonwood.
70---------- McPaul	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple.	Common hackberry, bur oak, ponderosa pine, green ash.	---
88---------- Nevin	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
93D2*: Shelby----------	Silky dogwood, gray dogwood.	Tatarian honeysuckle, lilac, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce, green ash.	Eastern white pine, silver maple.
Adair----------	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Green ash, Norway spruce, common hackberry.	Eastern white pine, silver maple.
99C, 99C2, 99D, 99D2, 99D3, 99E2- Exira	Silky dogwood, gray dogwood.	Redosier dogwood, lilac, Tatarian honeysuckle.	Amur maple, eastern redcedar.	Norway spruce, common hackberry, green ash.	Eastern white pine, silver maple.
112C2, 112D2------ Strahan	Gray dogwood, silky dogwood.	Lilac, Siberian peashrub, Amur privet.	Eastern redcedar, Amur maple, nannyberry viburnum.	Silver maple, eastern white pine, green ash.	---
133, 133+--------- Colo	Redosier dogwood, silky dogwood.	Siberian dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Eastern redcedar, white spruce, Amur maple, northern white-cedar.	Green ash----------	Silver maple, eastern cottonwood.
137---------- Haynie	Gray dogwood------	Amur privet, Siberian peashrub, lilac.	Osageorange, nannyberry viburnum, eastern redcedar.	Silver maple, eastern cottonwood, green ash.	---
144---------- Blake	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Russian-olive, eastern redcedar.	Common hackberry, eastern cottonwood, green ash.	---
146---------- Onawa	---	Lilac, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive.	Green ash, osageorange.	Eastern cottonwood.
149---------- Modale	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Russian-olive, eastern redcedar.	Osageorange, green ash, eastern cottonwood.	---
156---------- Albaton	---	Siberian peashrub, Tatarian honeysuckle, lilac.	Russian-olive, northern white-cedar, eastern redcedar.	Green ash, osageorange.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
192D2---------- Adair	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Green ash, Norway spruce, common hackberry.	Eastern white pine, silver maple.
212, 212+---------- Kennebec	Gray dogwood, redosier dogwood.	Tatarian honeysuckle, lilac, Siberian dogwood.	Amur maple, eastern redcedar.	Eastern white pine, common hackberry, Norway spruce.	Silver maple, eastern cottonwood.
220---------- Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, lilac, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce, green ash.	Eastern cottonwood, silver maple.
234---------- Nishna	---	Lilac, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar.	Green ash, common hackberry, osageorange.	Eastern cottonwood.
237, 238---------- Sarpy	---	Autumn-olive------	Eastern redcedar, Russian-olive.	---	---
244---------- Blend	Redosier dogwood.	Lilac, Tatarian honeysuckle, Siberian peashrub, American plum.	Northern white-cedar, Russian-olive.	Green ash, common hackberry, osageorange.	Eastern cottonwood.
255---------- Cooper	---	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar--	Green ash, common hackberry, osageorange.	Eastern cottonwood.
275---------- Moville	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Russian-olive, eastern redcedar.	Green ash, common hackberry, eastern cottonwood, osageorange.	---
430---------- Ackmore	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
436---------- Lakeport	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood.
509, 509B, 509C, 509C2---------- Marshall	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Norway spruce, common hackberry, green ash.	Eastern white pine, silver maple.
510B---------- Monona	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, Siberian dogwood.	Amur maple, eastern redcedar.	Green ash, Norway spruce, common hackberry.	Eastern white pine, silver maple.
514---------- Grable	---	Lilac, Siberian peashrub, Tatarian honeysuckle.	Russian-olive, nannyberry viburnum, eastern redcedar.	Osageorange, green ash.	---
515---------- Percival	---	Lilac, Siberian peashrub, Tatarian honeysuckle.	Russian-olive, eastern redcedar.	Green ash, osageorange.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
516---------- Vore	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Russian-olive, eastern redcedar.	Green ash, common hackberry, eastern cottonwood, osageorange.	---
555---------- Percival	---	Lilac, Siberian peashrub, Tatarian honeysuckle.	Russian-olive, eastern redcedar.	Green ash, osageorange.	Eastern cottonwood.
636---------- Buckney	---	Siberian peashrub, lilac, Tatarian honeysuckle.	Eastern redcedar, Russian-olive.	Common hackberry, green ash, osageorange.	---
670---------- Rawles	---	Lilac, Siberian peashrub, Tatarian honeysuckle.	Nannyberry viburnum, eastern redcedar, Russian-olive.	Eastern cottonwood, green ash, osageorange.	---
717*: Napier----------	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Norway spruce, common hackberry, green ash.	Eastern cottonwood, silver maple.
Gullied land.					
733---------- Calco	---	Tatarian honeysuckle, lilac.	Eastern redcedar, northern white-cedar, Russian-olive.	Green ash, osageorange.	Eastern cottonwood.
849---------- Kenmoor	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, Russian-olive.	Ponderosa pine, green ash, osageorange.	Eastern cottonwood.
1233---------- Corley	Common ninebark---	Autumn-olive, silky dogwood, Tatarian honeysuckle, redosier dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, white spruce.	Green ash---------	Eastern cottonwood, silver maple.
1299---------- Minden	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
5030*. Pits and dumps					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1C, 1C3 Ida	Slight	Slight	Severe: slope.	Severe: erodes easily.	Slight.
1D, 1D3 Ida	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
1E, 1E3 Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
1F, 1F3 Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
2G*: Hamburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
3E Castana	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
8B Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
8C Judson	Slight	Slight	Severe: slope.	Slight	Slight.
9 Marshall	Slight	Slight	Slight	Slight	Slight.
9B Marshall	Slight	Slight	Moderate: slope.	Slight	Slight.
9C, 9C2 Marshall	Slight	Slight	Severe: slope.	Slight	Slight.
9D, 9D2, 9D3 Marshall	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
10B Monona	Slight	Slight	Moderate: slope.	Slight	Slight.
10C, 10C2 Monona	Slight	Slight	Severe: slope.	Slight	Slight.
10D, 10D2, 10D3 Monona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
10E, 10E2, 10E3 Monona	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
10F2 Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
11B*: Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
11B*: Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
12B Napier	Slight	Slight	Moderate: slope.	Slight	Slight.
12C Napier	Slight	Slight	Severe: slope.	Slight	Slight.
22C2 Dow	Slight	Slight	Severe: slope.	Slight	Slight.
22D2 Dow	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
24D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
33D Steinauer	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
36 Salix	Slight	Slight	Slight	Slight	Slight.
43 Bremer	Severe: wetness, floods.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
44 Blencoe	Severe: wetness.	Severe: too clayey.	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey.
46 Keg	Slight	Slight	Slight	Slight	Slight.
54, 54+ Zook	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
60D2 Malvern	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
66+ Luton	Severe: wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
66 Luton	Severe: floods, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, floods.
67 Woodbury	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
70 McPaul	Slight	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
88---------- Nevin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
93D2*: Shelby----------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
Adair----------	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
99C, 99C2---------- Exira	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
99D, 99D2, 99D3------- Exira	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
99E2---------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
112C2, 112D2---------- Strahan	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
133, 133+---------- Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
137---------- Haynie	Slight----------	Slight----------	Slight----------	Slight----------	Severe: frost action, low strength.
144---------- Blake	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
146---------- Onawa	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
149---------- Modale	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
156---------- Albaton	Severe: floods, wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
192D2---------- Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
212+---------- Kennebec	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
212---------- Kennebec	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
220---------- Nodaway	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
234---------- Nishna	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: floods, wetness.
237---------- Sarpy	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
238---------- Sarpy	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
244---------- Blend	Severe: floods, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
255---------- Cooper	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight----------	Slight.
275---------- Moville	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
430---------- Ackmore	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
436---------- Lakeport	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
509---------- Marshall	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
509B---------- Marshall	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
509C, 509C2---------- Marshall	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
510B---------- Monona	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
514---------- Grable	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
515---------- Percival	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
516---------- Vore	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
555---------- Percival	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
636---------- Buckney	Severe: floods.	Slight----------	Slight----------	Slight----------	Moderate: droughty.
670---------- Rawles	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
717*: Napier----------	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
Gullied land.					
733---------- Calco	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
849---------- Kenmoor	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight----------	Moderate: droughty.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1233---------- Corley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1299---------- Minden	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
5030*. Pits and dumps					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1C, 1C3, 1D, 1D3--- Ida	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1E, 1E3---------- Ida	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
1F, 1F3---------- Ida	Poor	Fair	Good	Poor	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
2G*: Hamburg----------	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Ida----------	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
3E---------- Castana	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
8B---------- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8C---------- Judson	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
9, 9B---------- Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
9C, 9C2, 9D, 9D2, 9D3---------- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10B---------- Monona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10C, 10C2, 10D, 10D2, 10D3-------- Monona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10E, 10E2, 10E3---- Monona	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10F2---------- Monona	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
11B*: Colo----------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Judson----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
12B---------- Napier	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
12C---------- Napier	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
22C2, 22D2--------- Dow	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
24D2---------- Shelby	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
24E2---------- Shelby	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
33D---------- Steinauer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
36---------- Salix	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
43---------- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
44---------- Blencoe	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
46---------- Keg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
54, 54+---------- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
60D2---------- Malvern	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
66, 66+---------- Luton	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.
67---------- Woodbury	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.
70---------- McPaul	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
88---------- Nevin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
93D2*:										
Shelby----------	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Adair----------	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
99C, 99C2, 99D, 99D2, 99D3, 99E2-- Exira	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
112C2, 112D2------- Strahan	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
133, 133+---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
137---------- Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
144---------- Blake	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
146---------- Onawa	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.
149---------- Modale	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
156---------- Albaton	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
192D2---------- Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
212---------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
212+---------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
220---------- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
234---------- Nishna	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.
237, 238---------- Sarpy	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
244---------- Blend	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
255---------- Cooper	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
275---------- Moville	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
430---------- Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
436---------- Lakeport	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
509, 509B---------- Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
509C, 509C2-------- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
510B---------- Monona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
514---------- Grable	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
515---------- Percival	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair.
516---------- Vore	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
555---------- Percival	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair.
636---------- Buckney	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
670---------- Rawles	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
717*: Napier----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Gullied land.										

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
733---------- Calco	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Poor	Fair.
849---------- Kenmoor	Poor	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
1233---------- Corley	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
1299---------- Minden	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
5030*. Pits and dumps										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1C, 1C3---------- Ida	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action, low strength.	Slight.
1D, 1D3---------- Ida	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
1E, 1E3, 1F, 1F3-- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.	Severe: slope.
2G*: Hamburg----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Ida----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.	Severe: slope.
3E---------- Castana	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
8B---------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
8C---------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9, 9B---------- Marshall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
9C, 9C2---------- Marshall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9D, 9D2, 9D3------ Marshall	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
10B---------- Monona	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
10C, 10C2--------- Monona	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength, frost action.	Slight.
10D, 10D2, 10D3--- Monona	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
10E, 10E2, 10E3, 10F2---------- Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
11B*: Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Moderate: wetness, floods.
Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
12B Napier	Slight	Slight	Slight	Slight	Severe: low strength, frost action.	Slight.
12C Napier	Slight	Slight	Slight	Moderate: slope.	Severe: low strength, frost action.	Slight.
22C2 Dow	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
22D2 Dow	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
33D Steinauer	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
36 Salix	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
43 Bremer	Severe: wetness.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: low strength, floods, frost action.	Moderate: wetness, floods.
44 Blencoe	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
46 Keg	Slight	Slight	Slight	Slight	Severe: frost action, low strength.	Slight.
54, 54+ Zook	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, frost action.	Severe: floods.
60D2 Malvern	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
66 Luton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
66+---------- Luton	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, floods, shrink-swell.	Moderate: wetness, floods.
67---------- Woodbury	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action.	Severe: too clayey.
70---------- McPaul	Slight----------	Slight----------	Slight----------	Slight----------	Severe: frost action.	Slight.
88---------- Nevin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
93D2*: Shelby----------	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Adair----------	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
99C, 99C2---------- Exira	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
99D, 99D2, 99D3--- Exira	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
99E2---------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, frost action, slope.	Severe: slope.
112C2, 112D2------ Strahan	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
133, 133+---------- Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Severe: floods.
137---------- Haynie	Slight----------	Slight----------	Slight----------	Slight----------	Severe: frost action, low strength.	Severe: frost action, low strength.
144---------- Blake	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: frost action.	Slight.
146---------- Onawa	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Severe: too clayey.
149---------- Modale	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: low strength, shrink-swell.	Moderate: wetness.
156---------- Albaton	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, floods, shrink-swell.	Severe: too clayey.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
192D2--Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
212--Kennebec	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Moderate: floods.
212+--Kennebec	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Severe: floods.
220--Nodaway	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Severe: floods.
234--Nishna	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Moderate: floods, wetness.
237, 238--Sarpy	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
244--Blend	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, shrink-swell, low strength.	Severe: too clayey.
255--Cooper	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Moderate: shrink-swell, wetness.	Severe: frost action, low strength.	Slight.
275--Moville	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
430--Ackmore	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.
436--Lakeport	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
509, 509B--Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
509C, 509C2--Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
510B--Monona	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
514--Grable	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
515--Percival	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, shrink-swell.	Severe: too clayey.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
516---------- Vore	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
555---------- Percival	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, shrink-swell.	Severe: too clayey.
636---------- Buckney	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action.	Moderate: droughty.
670---------- Rawles	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.	Severe: floods.
717*: Napier----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength, frost action.	Slight.
Gullied land.						
733---------- Calco	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods.	Severe: floods.
849---------- Kenmoor	Moderate: too clayey, wetness.	Slight---------	Severe: shrink-swell.	Slight---------	Moderate: frost action.	Moderate: droughty.
1233---------- Corley	Severe: ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: low strength, frost action, ponding.	Moderate: ponding.
1299---------- Minden	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
5030*. Pits and dumps						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1C, 1C3---------- Ida	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
1D, 1D3---------- Ida	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
1E, 1E3, 1F, 1F3---- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
2G*:					
Hamburg----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ida----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
3E---------- Castana	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
8B---------- Judson	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
8C---------- Judson	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
9---------- Marshall	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
9B---------- Marshall	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
9C, 9C2---------- Marshall	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
9D, 9D2, 9D3-------- Marshall	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
10B---------- Monona	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
10C, 10C2---------- Monona	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
10D, 10D2, 10D3----- Monona	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
10E, 10E2, 10E3, 10F2---------- Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
11B*:					
Colo----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, hard to pack.
Judson----------	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
12B Napier	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
12C Napier	Slight	Severe: slope.	Slight	Slight	Good.
22C2 Dow	Slight	Severe: slope.	Slight	Slight	Good.
22D2 Dow	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
24D2 Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E2 Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
33D Steinauer	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
36 Salix	Moderate: wetness.	Moderate: wetness, seepage.	Severe: wetness.	Moderate: wetness.	Good.
43 Bremer	Severe: percs slowly, floods, wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
44 Blencoe	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
46 Keg	Slight	Moderate: seepage.	Slight	Slight	Good.
54, 54+ Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness, hard to pack.
60D2 Malvern	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
66 Luton	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, hard to pack.
66+ Luton	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey, hard to pack.
67 Woodbury	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, hard to pack.
70 McPaul	Slight	Moderate: seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
88---------- Nevin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
93D2*: Shelby----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Adair----------	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
99C, 99C2---------- Exira	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
99D, 99D2, 99D3----- Exira	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
99E2---------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
112C2, 112D2-------- Strahan	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
133, 133+---------- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, hard to pack.
137---------- Haynie	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
144---------- Blake	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: wetness.
146---------- Onawa	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: wetness.
149---------- Modale	Severe: percs slowly, wetness.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
156---------- Albaton	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, hard to pack, wetness.
192D2---------- Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
212, 212+---------- Kennebec	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
220---------- Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
234---------- Nishna	Severe: floods, percs slowly, wetness.	Severe: floods.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
237, 238---------- Sarpy	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
244---------- Blend	Severe: percs slowly, wetness.	Slight----------	Severe: too clayey, wetness.	Severe: wetness.	Poor: wetness, too clayey.
255---------- Cooper	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
275---------- Moville	Severe: percs slowly, wetness.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
430---------- Ackmore	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
436---------- Lakeport	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
509---------- Marshall	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
509B---------- Marshall	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
509C, 509C2--------- Marshall	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
510B---------- Monona	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
514---------- Grable	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
515---------- Percival	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: seepage, wetness.	Poor: seepage, too sandy.
516---------- Vore	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, seepage.
555---------- Percival	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: seepage, wetness.	Poor: seepage, too sandy.
636---------- Buckney	Severe: poor filter.	Severe: seepage, floods.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
670---------- Rawles	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
717*: Napier----------	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
Gullied land.					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
733---------- Calco	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
849---------- Kenmoor	Severe: wetness, percs slowly.	Severe: wetness, seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
1233---------- Corley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: wetness, hard to pack.
1299---------- Minden	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
5030*. Pits and dumps					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1C, 1C3---------- Ida	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
1D, 1D3---------- Ida	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
1E, 1E3---------- Ida	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1F, 1F3---------- Ida	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
2G*:				
Hamburg----------	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ida----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
3E---------- Castana	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
8B, 8C---------- Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9, 9B, 9C, 9C2-------- Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9D, 9D2, 9D3---------- Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
10B, 10C, 10C2-------- Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
10D, 10D2, 10D3------- Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
10E, 10E2, 10E3------- Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
10F2---------- Monona	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
11B*:				
Colo----------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Judson----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
12B, 12C---------- Napier	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
22C2---------- Dow	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
22D2---------- Dow	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24D2---------- Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
24E2---------- Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
33D---------- Steinauer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
36---------- Salix	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
43---------- Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
44---------- Blencoe	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
46---------- Keg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54---------- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
54+---------- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
60D2---------- Malvern	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
66---------- Luton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
66+---------- Luton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
67---------- Woodbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
70---------- McPaul	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
88---------- Nevin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
93D2*: Shelby----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Adair----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
99C, 99C2---------- Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
99D, 99D2, 99D3------- Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
99E2 Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
112C2, 112D2 Strahan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
133, 133+ Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
137 Haynie	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
144 Blake	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
146 Onawa	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
149 Modale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
156 Albaton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
192D2 Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
212, 212+ Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
220 Nodaway	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
234 Nishna	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
237 Sarpy	Good	Probable	Improbable: too sandy.	Fair: too sandy.
238 Sarpy	Good	Probable	Improbable: too sandy.	Good.
244 Blend	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
255 Cooper	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
275 Moville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
430 Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
436 Lakeport	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
509, 509B, 509C, 509C2---- Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
510B---- Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
514---- Grable	Good----	Probable----	Improbable: too sandy.	Fair: area reclaim.
515---- Percival	Fair: wetness.	Probable----	Improbable: too sandy.	Poor: too clayey.
516---- Vore	Fair: wetness.	Probable----	Improbable: too sandy.	Fair: too clayey, area reclaim.
555---- Percival	Fair: wetness.	Probable----	Improbable: too sandy.	Poor: too clayey.
636---- Buckney	Good----	Probable----	Improbable: too sandy.	Fair: thin layer.
670---- Rawles	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
717*: Napier----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gullied land.				
733---- Calco	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
849---- Kenmoor	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1233---- Corley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1299---- Minden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
5030*. Pits and dumps				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1C, 1C3---------- Ida	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
1D, 1D3, 1E, 1E3, 1F, 1F3---------- Ida	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
2G*: Hamburg----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ida----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
3E---------- Castana	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
8B, 8C---------- Judson	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
9---------- Marshall	Moderate: seepage.	Slight---------	Severe: no water.	Deep to water	Favorable------	Not needed-----	Erodes easily.
9B, 9C, 9C2------- Marshall	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
9D, 9D2, 9D3------ Marshall	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily, slope.	Slope, erodes easily.
10B, 10C, 10C2---- Monona	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
10D, 10D2, 10D3, 10E, 10E2, 10E3, 10F2---------- Monona	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
11B*: Colo----------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Floods, frost action.	Floods, wetness.	Wetness--------	Wetness.
Judson----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
12B, 12C---------- Napier	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
22C2---------- Dow	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily, slope.	Erodes easily	Erodes easily.
22D2---------- Dow	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily, slope.	Slope, erodes easily.	Slope, erodes easily.
24D2, 24E2-------- Shelby	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
33D---------- Steinauer	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
36---------- Salix	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Not needed-----	Erodes easily.
43---------- Bremer	Slight---------	Severe: wetness, hard to pack.	Severe: slow refill.	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
44---------- Blencoe	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness, slow intake.	Not needed-----	Wetness.
46---------- Keg	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Not needed-----	Erodes easily.
54, 54+---------- Zook	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Floods, percs slowly, frost action.	Wetness, percs slowly.	Not needed-----	Wetness, percs slowly.
60D2---------- Malvern	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
66---------- Luton	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly---	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, percs slowly.
66+---------- Luton	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, floods.	Wetness, percs slowly, floods.	Not needed-----	Wetness, percs slowly.
67---------- Woodbury	Slight---------	Severe: wetness, hard to pack.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly, slow intake.	Not needed-----	Wetness, erodes easily, percs slowly.
70---------- McPaul	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Not needed-----	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
88---------- Nevin	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Not needed-----	Erodes easily.
93D2*: Shelby----------	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
Adair----------	Severe: slope.	Moderate: wetness.	Moderate: wetness.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Slope, wetness.	Wetness, slope.
99C, 99C2--------- Exira	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
99D, 99D2, 99D3, 99E2---------- Exira	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
112C2, 112D2------ Strahan	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
133, 133+--------- Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Floods, frost action.	Floods, wetness.	Not needed-----	Wetness.
137---------- Haynie	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Not needed-----	Erodes easily.
144---------- Blake	Severe: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Not needed-----	Erodes easily.
146---------- Onawa	Severe: seepage.	Severe: piping.	Severe: slow refill.	Frost action---	Wetness, slow intake, percs slowly.	Not needed-----	Erodes easily, percs slowly.
149---------- Modale	Moderate: seepage.	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Not needed-----	Wetness, erodes easily, percs slowly.
156---------- Albaton	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, floods.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, percs slowly.
192D2---------- Adair	Severe: slope.	Moderate: wetness.	Moderate: wetness.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Slope, wetness.	Wetness, slope.
212, 212+--------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Floods---------	Not needed-----	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
220--- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Floods---	Not needed---	Erodes easily.
234--- Nishna	Slight---	Severe: hard to pack, wetness.	Severe: slow refill.	Floods, percs slowly.	Wetness, percs slowly, floods.	Not needed---	Wetness, percs slowly.
237--- Sarpy	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Not needed---	Droughty.
238--- Sarpy	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, soil blowing.	Not needed---	Droughty.
244--- Blend	Moderate: seepage.	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Not needed---	Wetness, percs slowly.
255--- Cooper	Moderate: seepage.	Severe: hard to pack.	Severe: slow refill.	Frost action, percs slowly.	Wetness, percs slowly.	Not needed---	Percs slowly.
275--- Moville	Slight---	Severe: wetness, hard to pack.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Not needed---	Wetness, percs slowly.
430--- Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Floods, frost action.	Wetness---	Not needed---	Wetness, erodes easily.
436--- Lakeport	Moderate: seepage.	Moderate: hard to pack, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness---	Not needed---	Erodes easily.
509--- Marshall	Moderate: seepage.	Slight---	Severe: no water.	Deep to water	Favorable---	Not needed---	Erodes easily.
509B, 509C, 509C2- Marshall	Moderate: seepage, slope.	Slight---	Severe: no water.	Deep to water	Slope---	Erodes easily	Erodes easily.
510B--- Monona	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope---	Erodes easily	Erodes easily.
514--- Grable	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable---	Not needed---	Favorable.
515--- Percival	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Favorable---	Wetness, slow intake, droughty.	Not needed---	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
516---------- Vore	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Floods, frost action, cutbanks cave.	Wetness---------	Not needed-----	Favorable.
555---------- Percival	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Favorable------	Wetness, slow intake, droughty.	Not needed-----	Percs slowly.
636---------- Buckney	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, soil blowing.	Not needed-----	Droughty.
670---------- Rawles	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Floods----------	Not needed-----	Favorable.
717*: Napier----------	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Gullied land.							
733---------- Calco	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Floods, frost action.	Floods, wetness.	Not needed-----	Wetness.
849---------- Kenmoor	Severe: seepage.	Severe: hard to pack.	Severe: no water.	Percs slowly---	Wetness, fast intake, droughty.	Not needed-----	Percs slowly, droughty.
1233---------- Corley	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Ponding, frost action.	Ponding---------	Not needed-----	Erodes easily, wetness.
1299---------- Minden	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Not needed-----	Erodes easily.
5030*. Pits and dumps							
5040*. Orthents							

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1C, 1C3, 1D, 1D3, 1E, 1E3, 1F, 1F3---------- Ida	0-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	95-100	30-40	5-15
20*:											
Hamburg---------	0-10	Silt loam--------	CL, CL-ML	A-4	0	100	100	100	95-100	20-30	5-10
	10-60	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-35	5-15
Ida----------	0-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	95-100	30-40	5-15
3E---------- Castana	0-11	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
	11-60	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
8B, 8C---------- Judson	0-28	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	28-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
9, 9B, 9C, 9C2, 9D, 9D2, 9D3---- Marshall	0-17	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	17-53	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	53-64	Silt loam--------	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
10B, 10C, 10C2, 10D, 10D2, 10D3, 10E, 10E2, 10E3, 10F2---------- Monona	0-15	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	15-35	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	35-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
11B*:											
Colo----------	0-31	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	31-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
Judson----------	0-28	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	28-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
12B, 12C--------- Napier	0-30	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
	30-60	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
22C2, 22D2------- Dow	0-7	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	95-100	25-40	8-15
	7-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	95-100	25-40	8-15
24D2, 24E2------- Shelby	0-14	Clay loam--------	CL	A-6, A-7-6	0	90-95	85-95	75-90	55-70	35-45	15-25
	14-42	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	42-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
33D---------- Steinauer	0-7	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-50	15-25
	7-13	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
	13-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	90-100	60-75	20-45	10-26
36---------- Salix	0-13	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	40-60	20-35
	13-27	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	20-30
	27-60	Silt loam, loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43----------	0-18	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
Bremer	18-48	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	48-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
44----------	0-21	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	30-50
Blencoe	21-28	Silty clay loam	CL	A-6	0	100	100	95-100	90-100	30-40	10-15
	28-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	85-100	30-40	5-15
46----------	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
Keg	11-60	Silt loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-35	5-15
54----------	0-17	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	17-60	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
54+----------	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Zook	13-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
60D2----------	0-5	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
Malvern	5-60	Silty clay-------	CH	A-7	0	100	100	100	95-100	55-80	30-45
66----------	0-14	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
Luton	14-25	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
	25-60	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
66+----------	0-11	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
Luton	11-25	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
	25-60	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
67----------	0-13	Silty clay-------	CH	A-7	0	100	100	100	95-100	60-85	35-60
Woodbury	13-34	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	60-85	35-60
	34-41	Silty clay loam	CH, CL	A-7	0	100	100	90-100	80-100	40-60	20-35
	41-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	80-95	30-40	5-15
70----------	0-60	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
McPaul											
88----------	0-28	Silty clay loam	CL, OL	A-6, A-7	0	100	100	100	90-95	35-45	10-20
Nevin	28-48	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	48-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
93D2*:											
Shelby----------	0-14	Clay loam--------	CL	A-6, A-7-6	0	90-95	85-95	75-90	55-70	35-45	15-25
	14-42	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	42-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
Adair----------	0-12	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	12-32	Clay loam--------	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	32-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
99C, 99C2, 99D, 99D2, 99D3, 99E2----------	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Exira	8-30	Silty clay loam	CL, ML	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	30-60	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
112C2, 112D2-----	0-7	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
Strahan	7-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
133----------	0-31	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
Colo	31-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
133+	0-12	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Colo	12-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
137	0-60	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
Haynie											
144	0-29	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	85-95	35-50	15-30
Blake	29-60	Silt loam, very fine sandy loam.	ML, CL	A-4, A-6	0	100	100	80-90	75-90	30-40	5-15
146	0-7	Silty clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
Onawa	7-28	Silty clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	28-60	Silt loam, very fine sandy loam, loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
149	0-28	Silt loam	CL	A-4, A-6	0	100	100	95-100	70-90	25-40	8-18
Modale	28-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	65-85	40-60
156	0-7	Silty clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
Albaton	7-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
192D2	0-12	Clay loam	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
Adair	12-32	Clay loam	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	32-60	Clay loam	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
212, 212+	0-38	Silt loam	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
Kennebec	38-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
220	0-60	Silt loam	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Nodaway											
234	0-15	Silty clay loam	CH, MH	A-7	0	100	100	95-100	90-100	55-65	25-35
Nishna	15-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	60-70	30-40
237	0-7	Loamy fine sand	SM	A-2-4	0	100	100	60-80	15-35	---	NP
Sarpy	7-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4	0	100	100	60-80	2-35	---	NP
238	0-7	Fine sandy loam	SM, SM-SC	A-4	0	100	100	70-85	40-50	<25	NP-5
Sarpy	7-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4	0	100	100	60-80	2-35	---	NP
244	0-17	Silty clay	CH	A-7	0	100	100	95-100	95-100	60-85	30-50
Blend	17-29	Silty clay loam	CL	A-6	0	100	100	95-100	85-100	30-40	11-20
	29-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	30-55
255	0-30	Silty clay loam	CL	A-7	0	100	100	95-100	85-100	40-50	20-30
Cooper	30-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-50
275	0-25	Silt loam	CL	A-4, A-6	0	100	100	95-100	90-100	30-40	8-18
Moville	25-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	65-85	40-60
430	0-24	Silt loam	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	8-20
Ackmore	24-60	Silty clay loam, silt loam.	CH, CL, MH, ML	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
436	0-19	Silty clay loam	CL, CH	A-7	0	100	100	95-100	90-100	40-60	20-35
Lakeport	19-46	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	40-60	20-35
	46-60	Silt loam, loam, clay loam.	CL	A-6	0	100	100	90-100	85-95	25-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
509, 509B, 509C, 509C2----------	0-17	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	17-53	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	53-64	Silt loam--------	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
510B----------	0-15	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	15-35	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	35-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
514----------	0-8	Silt loam--------	CL	A-4, A-6	0	100	100	80-95	50-75	25-40	8-20
Grable	8-21	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	80-95	50-75	25-40	8-20
	21-60	Fine sand, loamy sand, sand.	SM, SM-SC, SP-SM	A-2, A-3	0	100	100	65-80	5-35	<20	NP-5
515----------	0-20	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
Percival	20-60	Stratified fine sand to loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	80-95	12-30	<20	NP-5
516----------	0-16	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	90-100	35-50	15-25
Vore	16-60	Fine sand, loamy fine sand.	SW-SM, SP-SM, SM, SM-SC	A-3, A-2-4	0	100	100	80-90	5-20	<20	NP-5
555----------	0-20	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
Percival	20-60	Stratified fine sand to loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	80-95	12-30	<20	NP-5
636----------	0-22	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-2-4, A-4	0	100	100	80-95	30-60	<20	NP-7
Buckney	22-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2-4	0	100	100	65-90	10-30	---	NP
670----------	0-26	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	90-100	25-40	5-15
Rawles	26-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	90-100	30-45	10-20
717*:											
Napier----------	0-30	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
	30-60	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
Gullied land.											
733----------	0-33	Silty clay loam	CH, CL	A-7	0	100	100	95-100	85-100	40-60	15-30
Calco	33-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	100	100	90-100	80-100	30-45	10-20
849----------	0-24	Loamy fine sand	SM	A-2, A-4	0	100	100	75-95	15-45	---	NP
Kenmoor	24-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	75-95	40-70	25-45
1233----------	0-29	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	30-45	15-25
Corley	29-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	20-30
	60-68	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-45	15-25
1299----------	0-21	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
Minden	21-43	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	43-60	Silt loam--------	CL, ML	A-7, A-6	0	100	100	100	95-100	35-50	10-25
5030*. Pits and dumps											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
1C, 1C3, 1D, 1D3, 1E, 1E3, 1F, 1F3---- Ida	0-60	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	5-4	4L
2G*:								
Hamburg----------	0-10	0.6-2.0	0.20-0.24	7.4-8.4	Low----------	0.43	5	4L
	10-60	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.43		
Ida----------	0-60	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	5	4L
3E---------- Castana	0-11	0.6-2.0	0.22-0.24	7.4-8.4	Low----------	0.32	5	4L
	11-60	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
8B, 8C---------- Judson	0-28	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.28	5	7
	28-60	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.43		
9, 9B, 9C, 9C2, 9D, 9D2, 9D3---- Marshall	0-17	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.32	5	7
	17-53	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.43		
	53-64	0.6-2.0	0.20-0.22	6.6-7.3	Moderate------	0.43		
10B, 10C, 10C2, 10D, 10D2, 10D3, 10E, 10E2, 10E3, 10F2---- Monona	0-15	0.6-2.0	0.22-0.24	5.6-7.3	Moderate------	0.32	5-4	6
	15-35	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.43		
	35-60	0.6-2.0	0.20-0.22	6.6-8.4	Moderate------	0.43		
11B*:								
Colo----------	0-31	0.6-2.0	0.21-0.23	5.6-7.3	High----------	0.28	5	7
	31-60	0.6-2.0	0.18-0.20	6.1-7.3	High----------	0.28		
Judson----------	0-28	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.28	5	7
	28-60	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.43		
12B, 12C---------- Napier	0-30	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6
	30-60	0.6-2.0	0.20-0.22	6.1-8.4	Low----------	0.43		
22C2, 22D2---- Dow	0-7	0.6-2.0	0.22-0.24	6.6-8.4	Low----------	0.43	5-4	4L
	7-60	0.6-2.0	0.20-0.22	7.9-8.4	Low----------	0.43		
24D2, 24E2---- Shelby	0-14	0.2-0.6	0.16-0.18	5.6-7.3	Moderate------	0.28	4	6
	14-42	0.2-0.6	0.16-0.18	5.6-7.8	Moderate------	0.28		
	42-60	0.2-0.6	0.16-0.18	6.6-8.4	Moderate------	0.37		
33D---------- Steinauer	0-7	0.2-0.6	0.17-0.19	7.4-8.4	Moderate------	0.32	5	4L
	7-13	0.2-0.6	0.15-0.17	7.9-8.4	Moderate------	0.32		
	13-60	0.2-2.0	0.14-0.19	7.9-8.4	Moderate------	0.32		
36---------- Salix	0-13	0.6-2.0	0.21-0.23	6.1-7.8	Moderate------	0.28	5	6
	13-27	0.6-2.0	0.18-0.20	6.1-7.8	Moderate------	0.43		
	27-60	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
43---------- Bremer	0-18	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.28	5	7
	18-48	0.2-0.6	0.15-0.17	6.1-6.5	High----------	0.28		
	48-60	0.2-0.6	0.18-0.20	6.1-6.5	High----------	0.28		
44---------- Blencoe	0-21	0.06-0.2	0.12-0.14	6.1-7.3	High----------	0.28	5	4
	21-28	0.2-2.0	0.18-0.20	6.6-7.3	Moderate------	0.43		
	28-60	0.6-2.0	0.20-0.22	6.6-8.4	Moderate------	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
46----------	0-11	0.6-2.0	0.21-0.23	6.1-7.3	Low----------	0.28	5	6
Keg	11-60	0.6-2.0	0.20-0.22	6.1-8.4	Low----------	0.43		
54----------	0-17	0.2-0.6	0.21-0.23	5.6-7.3	High----------	0.28	5	7
Zook	17-60	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28		
54+----------	0-13	0.6-2.0	0.22-0.24	5.6-7.3	Moderate------	0.28	5	6
Zook	13-60	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28		
60D2----------	0-5	0.2-0.6	0.21-0.23	5.6-7.3	Moderate------	0.37	3	7
Malvern	5-60	0.06-0.2	0.12-0.14	6.1-7.3	High----------	0.37		
66----------	0-14	<0.06	0.12-0.14	6.6-7.8	High----------	0.28	5	4
Luton	14-25	<0.06	0.12-0.14	6.6-7.8	High----------	0.28		
	25-60	<0.06	0.11-0.13	6.6-8.4	High----------	0.28		
66+----------	0-11	0.6-2.0	0.22-0.24	6.6-7.8	Moderate------	0.28	5	6
Luton	11-25	<0.06	0.12-0.14	6.6-7.8	High----------	0.28		
	25-60	<0.06	0.11-0.13	6.6-8.4	High----------	0.28		
67----------	0-13	0.06-0.2	0.12-0.14	6.1-7.3	High----------	0.28	5	4
Woodbury	13-34	0.06-0.2	0.11-0.13	6.1-6.5	High----------	0.43		
	34-41	0.2-0.6	0.18-0.20	6.6-7.8	High----------	0.43		
	41-60	0.6-2.0	0.20-0.22	7.4-8.4	Moderate------	0.43		
70----------	0-60	0.6-2.0	0.21-0.23	7.4-8.4	Low----------	0.37	5	4L
McPaul								
88----------	0-28	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.32	5	7
Nevin	28-48	0.6-2.0	0.18-0.20	6.1-6.5	Moderate------	0.43		
	48-60	0.6-2.0	0.18-0.20	6.6-7.3	Moderate------	0.43		
93D2*:								
Shelby----------	0-14	0.2-0.6	0.16-0.18	5.6-7.3	Moderate------	0.28	4	6
	14-42	0.2-0.6	0.16-0.18	5.6-7.8	Moderate------	0.28		
	42-60	0.2-0.6	0.16-0.18	6.6-8.4	Moderate------	0.37		
Adair----------	0-12	0.2-0.6	0.17-0.19	5.6-7.3	Moderate------	0.32	2	6
	12-32	0.06-0.2	0.13-0.16	5.1-6.5	High----------	0.32		
	32-60	0.2-0.6	0.14-0.16	5.6-7.8	Moderate------	0.32		
99C, 99C2, 99D, 99D2, 99D3, 99E2----------	0-8	0.6-2.0	0.21-0.23	5.6-6.5	Moderate------	0.32	5-4	7
Exira	8-30	0.6-2.0	0.18-0.20	5.6-6.5	Moderate------	0.43		
	30-60	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.43		
112C2, 112D2-----	0-7	0.6-2.0	0.22-0.24	6.6-7.3	Low----------	0.43	5	6
Strahan	7-60	0.6-2.0	0.20-0.22	6.6-7.8	Low----------	0.43		
133----------	0-31	0.6-2.0	0.21-0.23	5.6-7.3	High----------	0.28	5	7
Colo	31-60	0.6-2.0	0.18-0.20	6.1-7.3	High----------	0.28		
133+----------	0-12	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.28	5	6
Colo	12-60	0.6-2.0	0.18-0.20	6.1-7.3	High----------	0.28		
137----------	0-60	0.6-2.0	0.18-0.23	7.4-8.4	Low----------	0.37	5	4L
Haynie								
144----------	0-29	0.6-2.0	0.20-0.22	7.4-8.4	Moderate------	0.37	5	4L
Blake	29-60	0.6-6.0	0.20-0.22	7.4-8.4	Low----------	0.37		
146----------	0-7	0.06-0.2	0.12-0.14	7.4-8.4	High----------	0.32	5	4
Onawa	7-28	0.06-0.2	0.12-0.14	7.4-8.4	High----------	0.32		
	28-60	0.6-6.0	0.20-0.22	7.4-8.4	Low----------	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
149	0-28	0.6-2.0	0.21-0.23	7.4-8.4	Moderate	0.37	5	4L
Modale	28-60	<0.2	0.11-0.13	7.4-8.4	High	0.28		
156	0-7	<0.2	0.11-0.13	7.4-8.4	High	0.28	5	4
Albaton	7-60	<0.2	0.11-0.13	7.4-8.4	High	0.28		
192D2	0-12	0.2-0.6	0.17-0.19	5.6-7.3	Moderate	0.32	2	6
Adair	12-32	0.06-0.2	0.13-0.16	5.1-6.5	High	0.32		
	32-60	0.2-0.6	0.14-0.16	5.6-7.8	Moderate	0.32		
212, 212+	0-38	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	0.32	5	6
Kennebec	38-60	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.43		
220	0-60	0.6-2.0	0.20-0.23	6.1-7.3	Moderate	0.37	5	6
Nodaway								
234	0-15	0.06-0.2	0.12-0.14	7.4-8.4	High	0.37	5	4
Nishna	15-60	0.06-0.2	0.11-0.13	7.4-8.4	High	0.28		
237	0-7	>6.0	0.05-0.09	6.6-8.4	Low	0.15	5	2
Sarpy	7-60	>6.0	0.05-0.09	7.4-8.4	Low	0.15		
238	0-7	2.0-6.0	0.09-0.13	6.6-8.4	Low	0.20	5	3
Sarpy	7-60	>6.0	0.05-0.09	7.4-8.4	Low	0.15		
244	0-17	<0.06	0.12-0.14	5.6-7.3	High	0.37	5	4
Blend	17-29	0.6-2.0	0.18-0.20	6.1-7.8	Moderate	0.28		
	29-60	<0.06	0.11-0.13	6.1-7.8	High	0.28		
255	0-30	0.6-2.0	0.19-0.21	6.1-7.8	Moderate	0.28	5	4
Cooper	30-60	0.06-0.2	0.11-0.13	6.6-8.4	High	0.28		
275	0-25	0.6-2.0	0.21-0.23	7.4-8.4	Low	0.32	5	4L
Moville	25-60	<0.06	0.11-0.13	6.6-7.8	High	0.32		
430	0-24	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.37	5	6
Ackmore	24-60	0.6-2.0	0.18-0.20	5.6-7.8	High	0.37		
436	0-19	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28	5	4
Lakeport	19-46	0.6-2.0	0.17-0.19	6.6-8.4	High	0.28		
	46-60	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.43		
509, 509B, 509C, 509C2	0-17	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7
Marshall	17-53	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.43		
	53-64	0.6-2.0	0.20-0.22	6.6-7.3	Moderate	0.43		
510B	0-15	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	0.32	5	6
Monona	15-35	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.43		
	35-60	0.6-2.0	0.20-0.22	6.6-8.4	Moderate	0.43		
514	0-8	0.6-2.0	0.22-0.24	7.4-8.4	Low	0.32	4	4L
Grable	8-21	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.43		
	21-60	6.0-20	0.02-0.07	7.4-8.4	Low	0.15		
515	0-20	0.06-0.2	0.12-0.14	7.4-8.4	High	0.28	4	4
Percival	20-60	6.0-20	0.06-0.08	7.4-8.4	Low	0.15		
516	0-16	0.6-2.0	0.19-0.22	7.4-8.4	Moderate	0.32	4	4L
Vore	16-60	6.0-20	0.05-0.07	7.4-8.4	Low	0.10		
555	0-20	0.06-0.2	0.12-0.14	7.4-8.4	High	0.28	4	4
Percival	20-60	6.0-20	0.06-0.08	7.4-8.4	Low	0.15		
636	0-22	2.0-6.0	0.12-0.18	6.6-7.8	Low	0.17	4	3
Buckney	22-60	6.0-20	0.04-0.10	7.4-8.4	Low	0.17		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
670----------	0-26	0.6-2.0	0.21-0.23	6.6-8.4	Moderate------	0.32	5	4L
Rawles	26-60	0.6-2.0	0.19-0.21	6.1-7.8	Moderate------	0.32		
717*:								
Napier----------	0-30	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6
	30-60	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.43		
Gullied land.								
733----------	0-33	0.6-2.0	0.21-0.23	7.4-8.4	High---------	0.28	5	7
Calco	33-60	0.6-2.0	0.18-0.20	7.4-8.4	Moderate------	0.28		
849----------	0-24	>6.0	0.10-0.12	6.6-8.4	Low----------	0.17	4	2
Kenmoor	24-60	0.06-0.2	0.12-0.19	6.6-8.4	High---------	0.32		
1233----------	0-29	0.6-2.0	0.22-0.24	5.1-7.3	Moderate------	0.28	5	6
Corley	29-60	0.6-2.0	0.18-0.20	5.1-6.5	High---------	0.43		
	60-68	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.43		
1299----------	0-21	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.28	5	7
Minden	21-43	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.43		
	43-60	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.43		
5030*. Pits and dumps								
5040*. Orthents								

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
1C, 1C3, 1D, 1D3, 1E, 1E3, 1F, 1F3-Ida	B	None	---	---	>6.0	---	---	High	Low	Low.
2G*:										
Hamburg	B	None	---	---	>6.0	---	---	High	Low	Low.
Ida	B	None	---	---	>6.0	---	---	High	Low	Low.
3E-Castana	B	None	---	---	>6.0	---	---	High	Low	Low.
8B, 8C-Judson	B	None	---	---	>6.0	---	---	High	Moderate	Low.
9, 9B, 9C, 9C2, 9D, 9D2, 9D3-Marshall	B	None	---	---	>6.0	---	---	High	Moderate	Moderate.
10B, 10C, 10C2, 10D, 10D2, 10D3, 10E, 10E2, 10E3, 10F2-Monona	B	None	---	---	>6.0	---	---	High	Low	Low.
11B*:										
Colo	B/D	Common	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Moderate.
Judson	B	None	---	---	>6.0	---	---	High	Moderate	Low.
12B, 12C-Napier	B	None	---	---	>6.0	---	---	High	Low	Low.
22C2, 22D2-Dow	B	None	---	---	>6.0	---	---	High	Low	Low.
24D2, 24E2-Shelby	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
33D-Steinauer	B	None	---	---	>6.0	---	---	Moderate	High	Low.
36-Salix	B	Rare	---	---	4.0-6.0	Apparent	Nov-Jul	High	Moderate	Low.
43-Bremer	C	Occasional	Very brief	Feb-Nov	1.0-2.0	Apparent	Nov-Jul	High	Moderate	Moderate.
44-Blencoe	D	Rare	---	---	1.0-3.0	Apparent	Nov-Jul	High	High	Low.
46-Keg	B	Rare	---	---	>6.0	---	---	High	Low	Low.
54, 54+-Zook	C/D	Frequent	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	High	High	Moderate.
60D2-Malvern	C	None	---	---	1.0-3.0	Perched	Nov-Jul	High	High	Moderate.
66-Luton	D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-Jul	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
66+---------- Luton	D	Occasional	Brief-----	Mar-Jun	1.0-3.0	Apparent	Nov-Jul	Moderate	High-----	Low.
67---------- Woodbury	D	Common------	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
70---------- McPaul	B	Common------	Very brief	Feb-Nov	>6.0	---	---	High-----	Low------	Low.
88---------- Nevin	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
93D2*: Shelby----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Adair----------	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
99C, 99C2, 99D, 99D2, 99D3, 99E2- Exira	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
112C2, 112D2------ Strahan	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
133, 133+--------- Colo	B/D	Common------	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
137---------- Haynie	B	Common------	Very brief	Feb-Nov	>6.0	---	---	High-----	Low------	Low.
144---------- Blake	B	Occasional	Very brief	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
146---------- Onawa	D	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
149---------- Modale	C	Common------	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
156---------- Albaton	D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	Moderate	High-----	Low.
192D2--------- Adair	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
212---------- Kennebec	B	Rare--------	---	---	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Low.
212+--------- Kennebec	B	Frequent----	Brief-----	Feb-Nov	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Low.
220---------- Nodaway	B	Frequent----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	High-----	Moderate	Low.
234---------- Nishna	C/D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	Moderate	High-----	Low.
237, 238---------- Sarpy	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
244---------- Blend	D	Rare--------	---	---	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
255---------- Cooper	B	Rare--------	---	---	2.0-5.0	Apparent	Nov-Jul	High-----	High-----	Low.
275---------- Moville	C	Common------	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
430---------- Ackmore	B	Frequent----	Very brief to brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
436---------- Lakeport	B	Rare--------	---	---	2.0-4.0	Apparent	Nov-Jun	High-----	High-----	Low.
509, 509B, 509C, 509C2---------- Marshall	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
510B---------- Monona	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
514---------- Grable	B	Common------	Very brief	Feb-Nov	>6.0	---	---	Low------	Low------	Low.
515---------- Percival	C	Common------	Very brief	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	Moderate	High-----	Low.
516---------- Vore	B	Common------	Very brief	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
555---------- Percival	C	Common------	Very brief	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	Moderate	High-----	Low.
636---------- Buckney	B	Rare--------	---	---	>6.0	---	---	Moderate	Low------	Low.
670---------- Rawles	B	Frequent----	Brief-----	Feb-Nov	>6.0	---	---	High-----	Moderate	Low.
717*: Napier----------	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
Gullied land.										
733---------- Calco	B/D	Frequent----	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
849---------- Kenmoor	B	None--------	---	---	2.5-3.0	Perched	Nov-Jun	Moderate	High-----	Low.
1233---------- Corley	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
1299---------- Minden	B	None--------	---	---	3.0-5.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
5030*. Pits and dumps										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Ackmore	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
Albaton	Fine, montmorillonitic (calcareous), mesic Vertic Fluvaquents
Blake	Fine-silty, mixed (calcareous), mesic Aquic Udifluvents
Blencoe	Clayey over loamy, montmorillonitic, mesic Aquic Hapludolls
Blend	Fine, montmorillonitic, mesic Fluvaquentic Haplaquolls
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
*Buckney	Coarse-loamy, mixed, mesic Entic Hapludolls
Calco	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Castana	Fine-silty, mixed, mesic Entic Hapludolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Cooper	Fine-silty over clayey, mixed, mesic Aquic Hapludolls
Corley	Fine-silty, mixed, mesic Argiaquic Argialbolls
Dow	Fine-silty, mixed (calcareous), mesic Typic Udorthents
Exira	Fine-silty, mixed, mesic Typic Hapludolls
Grable	Coarse-silty over sandy or sandy-skeletal, mixed (calcareous), mesic Mollic Udifluvents
Hamburg	Coarse-silty, mixed (calcareous), mesic Typic Udorthents
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Ida	Fine-silty, mixed (calcareous), mesic Typic Udorthents
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Keg	Fine-silty, mixed, mesic Typic Hapludolls
Kenmoor	Sandy over clayey, mixed (calcareous), mesic Aquic Udifluvents
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
*Lakeport	Fine, montmorillonitic, mesic Aquic Hapludolls
Luton	Fine, montmorillonitic, mesic Vertic Haplaquolls
*Malvern	Fine, montmorillonitic, mesic Aquic Argiudolls
Marshall	Fine-silty, mixed, mesic Typic Hapludolls
McPaul	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Minden	Fine-silty, mixed, mesic Aquic Hapludolls
Modale	Coarse-silty over clayey, mixed (calcareous), mesic Aquic Udifluvents
Monona	Fine-silty, mixed, mesic Typic Hapludolls
Moville	Coarse-silty over clayey, mixed (calcareous), mesic Aeric Fluvaquents
Napier	Fine-silty, mixed, mesic Cumulic Hapludolls
Nevin	Fine-silty, mixed, mesic Aquic Argiudolls
Nishna	Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Onawa	Clayey over loamy, montmorillonitic (calcareous), mesic Mollic Fluvaquents
Orthents	Loamy, mixed, mesic Typic Udorthents
Percival	Clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), mesic Aquic Udifluvents
Rawles	Fine-silty, mixed (calcareous), mesic Mollic Udifluvents
Salix	Fine-silty, mixed, mesic Typic Hapludolls
Sarpy	Mixed, mesic Typic Udipsamments
*Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Strahan	Fine-silty, mixed, nonacid, mesic Typic Udorthents
Vore	Fine-silty over sandy or sandy-skeletal, mixed (calcareous), mesic Aquic Udifluvents
Woodbury	Fine, montmorillonitic, mesic Vertic Haplaquolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

* U.S. GOVERNMENT PRINTING OFFICE: 1982 -354-392/1085

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DEPARTMENT OF SOIL CONSERVATION, STATE OF IOWA

GENERAL SOIL MAP

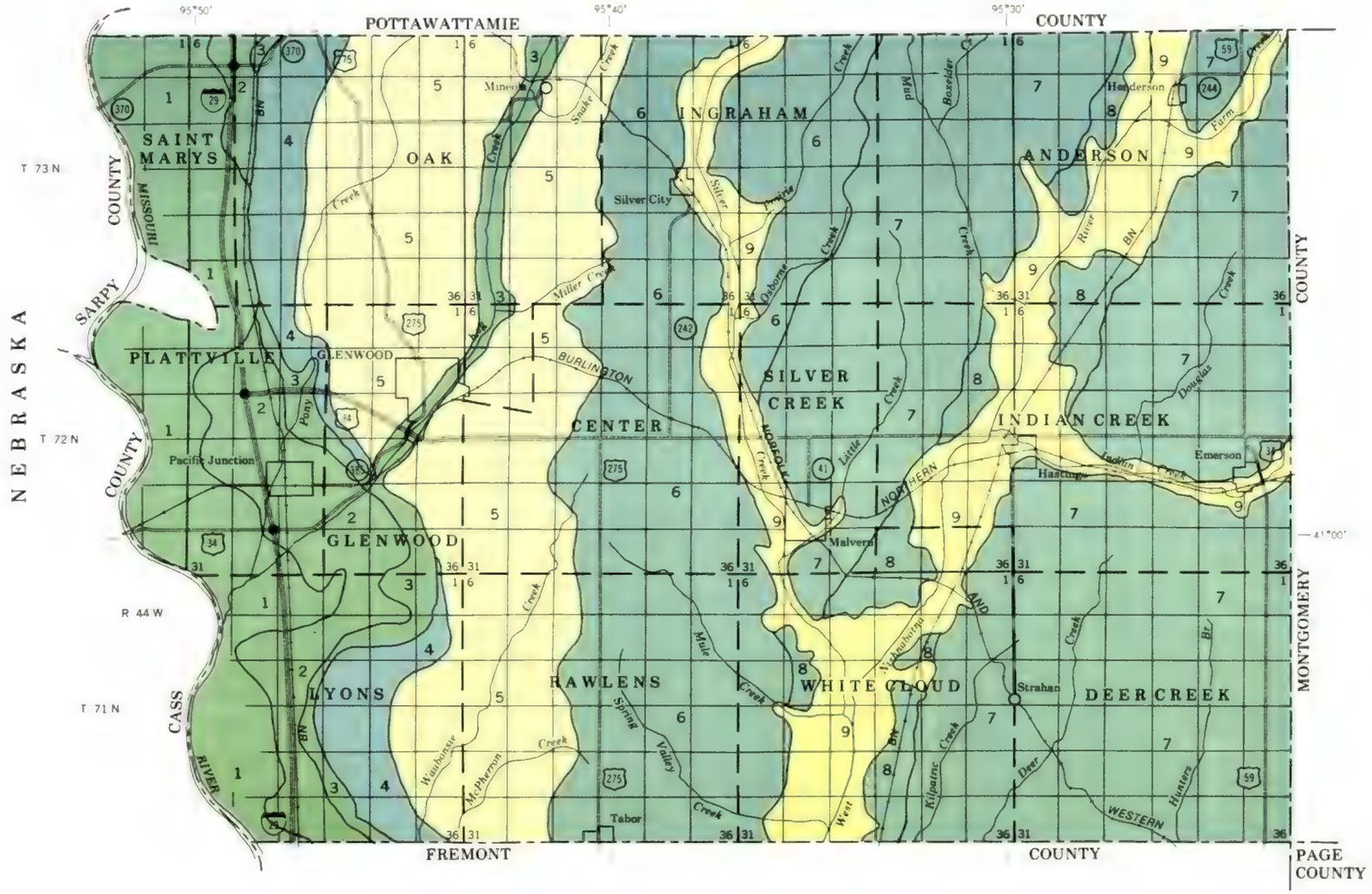
MILLS COUNTY, IOWA

Scale 1:190,080

0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N



SOIL LEGEND

AREAS DOMINATED BY NEARLY LEVEL AND GENTLY SLOPING SOILS ON BOTTOM LAND ALONG THE MISSOURI RIVER

1 — Haynie-Albaton-Onawa association: Nearly level, well drained to poorly drained soils formed in alluvium on bottom land

2 — Keg-Salix-Luton association. Nearly level, well drained, moderately well drained, poorly drained, and very poorly drained soils formed in alluvium on bottom land

3 — McPaul-Napier-Moville association: Nearly level and gently sloping, well drained to somewhat poorly drained soils formed in alluvium on bottom land and foot slopes and in upland drainageways

AREAS DOMINATED BY MODERATELY SLOPING TO VERY STEEP SOILS ON UPLANDS

4 — Ida-Hamburg association: Moderately sloping to very steep, well drained and somewhat excessively drained soils formed in loess on uplands

AREAS DOMINATED BY GENTLY SLOPING TO STEEP SOILS ON UPLANDS

5 — Monona-Ida association: Gently sloping to steep, well drained soils formed in loess on uplands

AREAS DOMINATED BY NEARLY LEVEL TO STRONGLY SLOPING SOILS ON UPLANDS

6 — Monona-Marshall association: Nearly level to strongly sloping, well drained soils formed in loess on uplands

7 — Marshall association: Nearly level to strongly sloping, well drained soils formed in loess on uplands

8 — Marshall-Minden association: Nearly level to moderately sloping, well drained and somewhat poorly drained soils formed in loess on benches

AREAS DOMINATED BY NEARLY LEVEL SOILS ON BOTTOM LAND

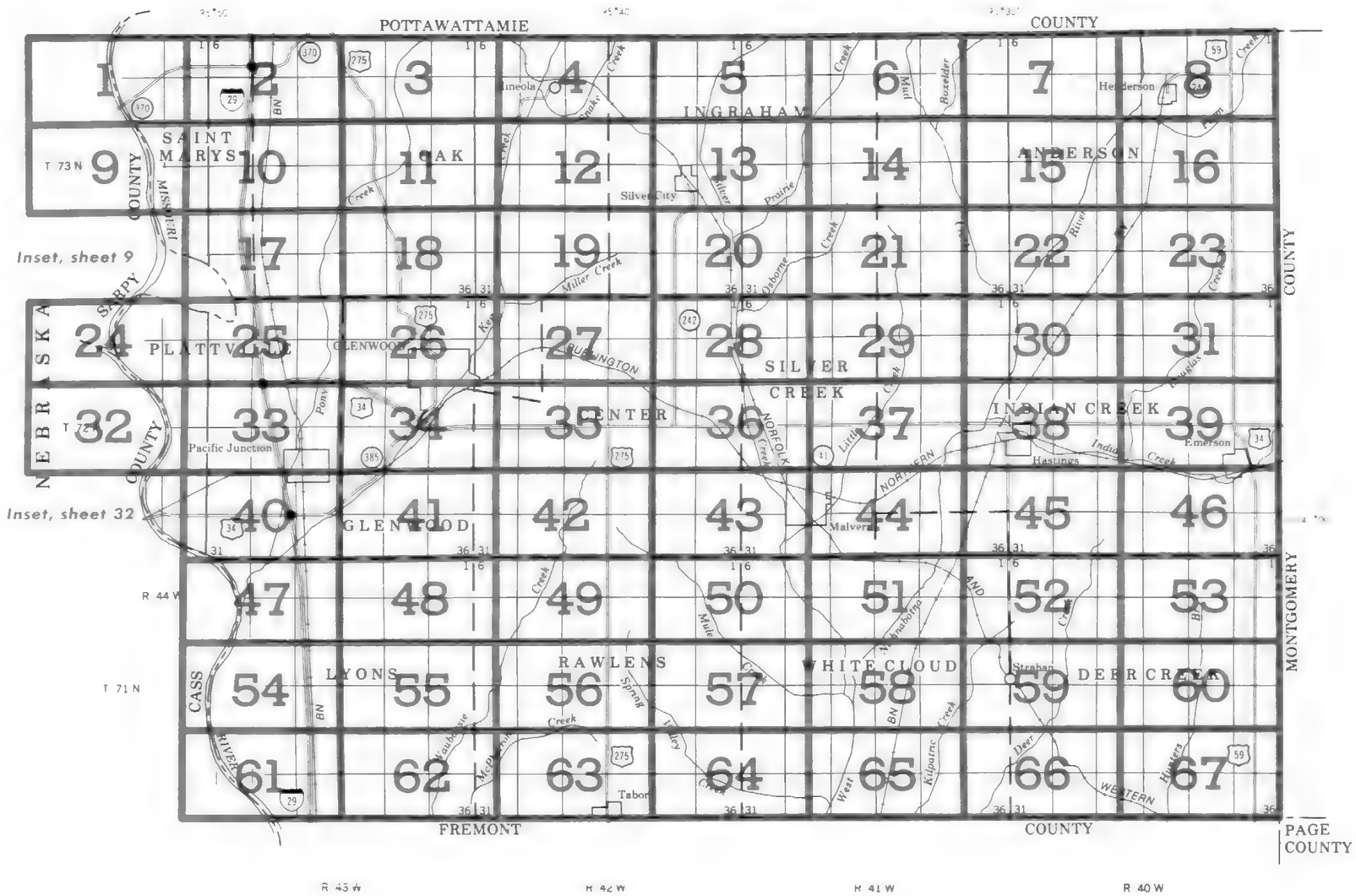
9 — Zook-Nodaway-Colo association: Nearly level, poorly drained and moderately well drained soils formed in alluvium on bottom land

Compiled 1981

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS

MILLS COUNTY, IOWA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N

Original text from each individual map sheet read:
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Crossable with tillage implements
- Not crossable with tillage implements
- Drainage end
- Canals or ditches
- Double line (label)
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Small area of Dow soil
- Small area of Strahan soil
- Small area of Malvern soil
- Small area of Ida-like soil
- Small area of Adair soil
- Glacial till outcrop
- Sewage lagoon (S.L)

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded and 3 that it is severely eroded.

SYMBOL	NAME
1C	Ida silt loam, 5 to 9 percent slopes
1C3	Ida silt loam, 5 to 9 percent slopes, severely eroded
1D	Ida silt loam, 9 to 14 percent slopes
1D3	Ida silt loam, 9 to 14 percent slopes, severely eroded
1E	Ida silt loam, 14 to 20 percent slopes
1E3	Ida silt loam, 14 to 20 percent slopes, severely eroded
1F	Ida silt loam, 20 to 30 percent slopes
1F3	Ida silt loam, 20 to 30 percent slopes, severely eroded
2G	Hamburg-Ida silt loams, 30 to 75 percent slopes
3E	Castana silt loam, 9 to 20 percent slopes
8B	Judson silty clay loam, 2 to 5 percent slopes
8C	Judson silty clay loam, 5 to 9 percent slopes
9	Marshall silty clay loam, 0 to 2 percent slopes
9B	Marshall silty clay loam, 2 to 5 percent slopes
9C	Marshall silty clay loam, 5 to 9 percent slopes
9C2	Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded
9D	Marshall silty clay loam, 9 to 14 percent slopes
9D2	Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded
9D3	Marshall silty clay loam, 9 to 14 percent slopes, severely eroded
10B	Monona silt loam, 2 to 5 percent slopes
10C	Monona silt loam, 5 to 9 percent slopes
10C2	Monona silt loam, 5 to 9 percent slopes, moderately eroded
10D	Monona silt loam, 9 to 14 percent slopes
10D2	Monona silt loam, 9 to 14 percent slopes, moderately eroded
10D3	Monona silt loam, 9 to 14 percent slopes, severely eroded
10E	Monona silt loam, 14 to 20 percent slopes
10E2	Monona silt loam, 14 to 20 percent slopes, moderately eroded
10E3	Monona silt loam, 14 to 20 percent slopes, severely eroded
10F2	Monona silt loam, 20 to 30 percent slopes, moderately eroded
11B	Colo-Judson silty clay loams, 2 to 5 percent slopes
12B	Napier silt loam, 2 to 5 percent slopes
12C	Napier silt loam, 5 to 9 percent slopes
22C2	Dow silt loam, 5 to 9 percent slopes, moderately eroded
22D2	Dow silt loam, 9 to 14 percent slopes, moderately eroded
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded
33D	Steinauer clay loam, 11 to 18 percent slopes
36	Salix silty clay loam, 0 to 2 percent slopes
43	Bremer silty clay loam, 0 to 2 percent slopes
44	Blencoe silty clay, 0 to 2 percent slopes
46	Keg silt loam, 0 to 2 percent slopes
54	Zook silty clay loam, 0 to 2 percent slopes
54+	Zook silt loam, overwash, 0 to 2 percent slopes
60D2	Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded
66	Luton silty clay, 0 to 2 percent slopes
66+	Luton silt loam, overwash, 0 to 2 percent slopes
67	Woodbury silty clay, 0 to 2 percent slopes
70	McPaul silt loam, 0 to 2 percent slopes
88	Nevin silty clay loam, 0 to 2 percent slopes
93D2	Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded
99C	Exira silty clay loam, 5 to 9 percent slopes
99C2	Exira silty clay loam, 5 to 9 percent slopes, moderately eroded
99D	Exira silty clay loam, 9 to 14 percent slopes
99D2	Exira silty clay loam, 9 to 14 percent slopes, moderately eroded
99D3	Exira silty clay loam, 9 to 14 percent slopes, severely eroded
99E2	Exira silty clay loam, 14 to 20 percent slopes, moderately eroded
112C2	Strahan silt loam, 5 to 9 percent slopes, moderately eroded
112D2	Strahan silt loam, 9 to 14 percent slopes, moderately eroded
133	Colo silty clay loam, 0 to 2 percent slopes
133+	Colo silt loam, overwash, 0 to 2 percent slopes
137	Haynie silt loam, 0 to 2 percent slopes
144	Blake silty clay loam, 0 to 2 percent slopes
146	Onawa silty clay, 0 to 2 percent slopes
149	Modale silt loam, 0 to 2 percent slopes
156	Albaton silty clay, 0 to 2 percent slopes
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded
212	Kennebec silt loam, 0 to 2 percent slopes
212+	Kennebec silt loam, overwash, 0 to 2 percent slopes
220	Nodaway silt loam, 0 to 2 percent slopes
234	Nishna silty clay loam, 0 to 2 percent slopes
237	Sarpy loamy fine sand, 1 to 3 percent slopes
238	Sarpy fine sandy loam, 0 to 2 percent slopes
244	Blend silty clay, 0 to 2 percent slopes
255	Cooper silty clay loam, 0 to 2 percent slopes
275	Moville silt loam, 0 to 2 percent slopes
430	Ackmore silt loam, 0 to 2 percent slopes
436	Lakeport silty clay loam, 0 to 2 percent slopes
509	Marshall silty clay loam, benches, 0 to 2 percent slopes
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes
509C	Marshall silty clay loam, benches, 5 to 9 percent slopes
509C2	Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded
510B	Monona silt loam, benches, 2 to 5 percent slopes
514	Grable silt loam, 0 to 2 percent slopes
515	Percival silty clay, 0 to 2 percent slopes
516	Vore silty clay loam, 0 to 2 percent slopes
555	Percival silty clay, dark surface, 0 to 2 percent slopes
636	Buckney fine sandy loam, 0 to 2 percent slopes
670	Rawles silt loam, 0 to 2 percent slopes
717	Napier-Gullied land complex, 2 to 10 percent slopes
733	Calco silty clay loam, 0 to 2 percent slopes
849	Kenmoor loamy fine sand, 0 to 2 percent slopes
1233	Corley silt loam, 0 to 1 percent slopes
1299	Minden silty clay loam, 0 to 2 percent slopes
5030	Pits and dumps, quarry
5040	Orthents, loamy

MILLS COUNTY, IOWA — SHEET NUMBER 1

POTTAWATTAMIE COUNTY

R 44 W

T 73 N

MISSOURI RIVER

SARPY COUNTY

NEBRASKA

(Joins sheet 2)

(Joins sheet 9)

1,350,000 FEET

N

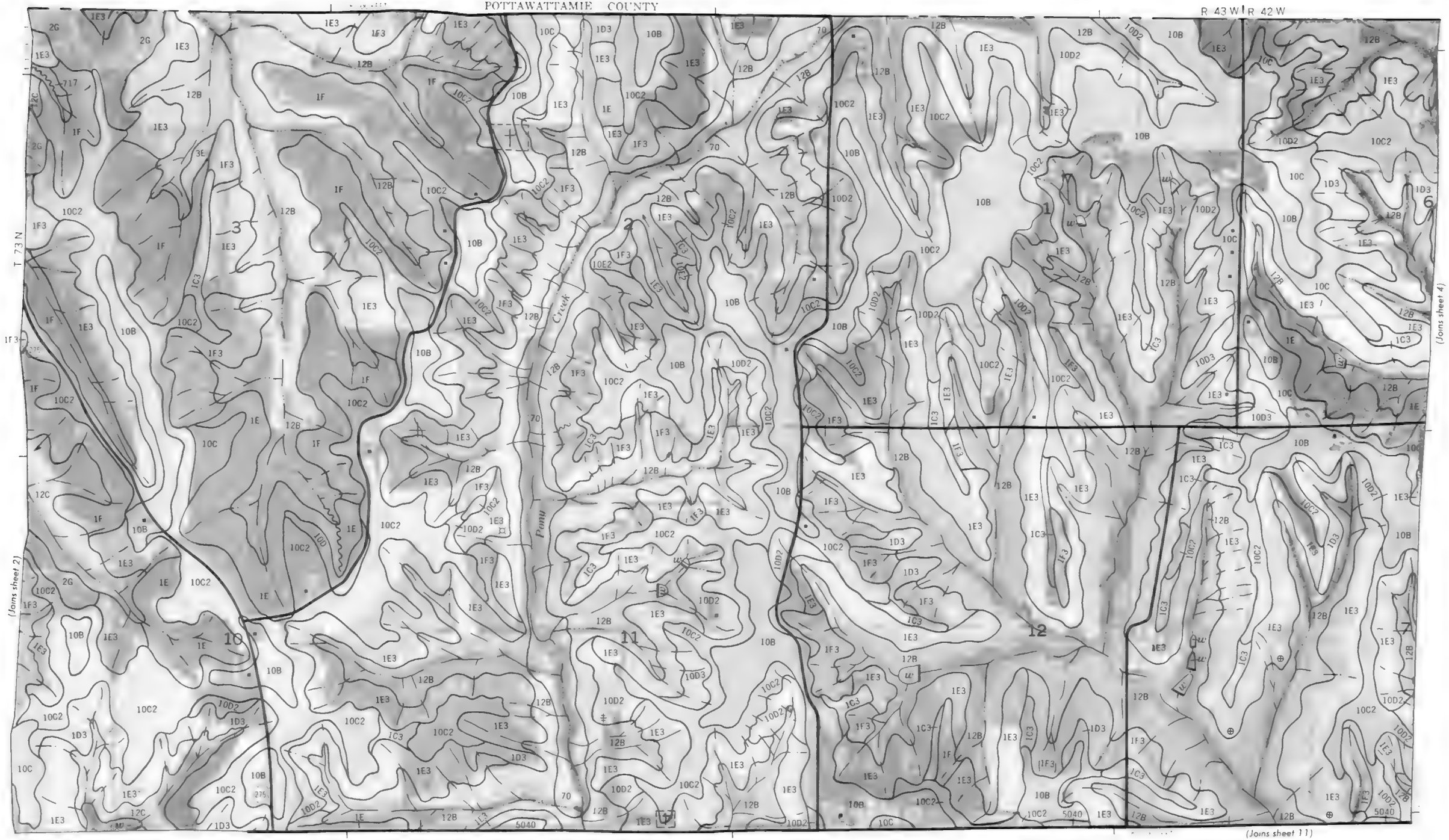
1 Mile

5,000 Feet

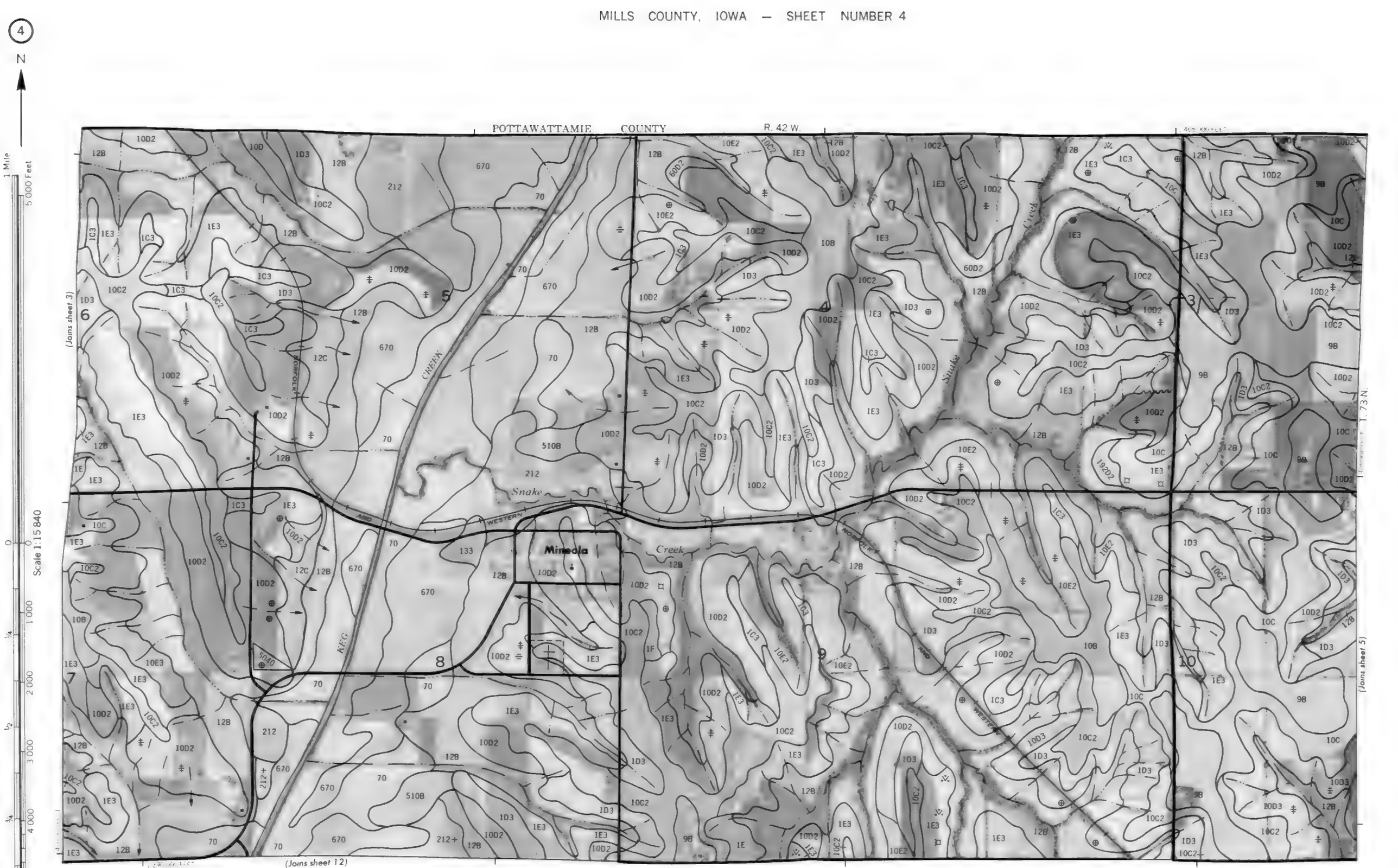
Scale 1:15 840


R. 44 W.
R. 43 W.
POTTAWATTAMIE COUNTY
T 73 N
NORTHERN
BURLINGTON
Ditch
Marus
int
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 10)
1 Mile
5,000 Feet
Scale 1:15 840

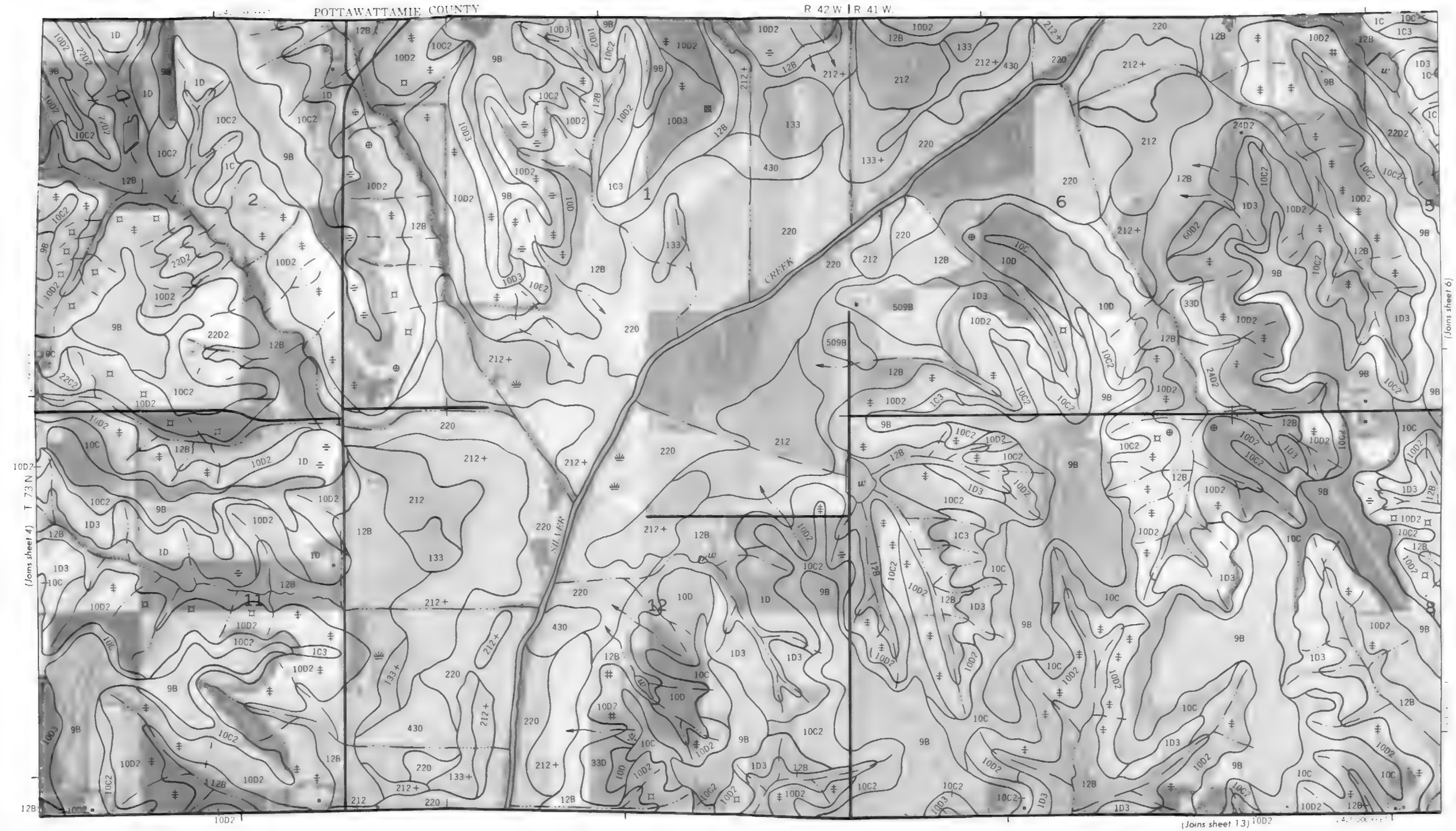
MILLS COUNTY, IOWA — SHEET NUMBER 3



MILLS COUNTY, IOWA — SHEET NUMBER 4



4
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼ 1 000
½ 2 000
¾ 3 000
1 4 000
1¼ 5 000


POTTAWATTAMIE COUNTY
R 42 W
R 41 W.
T 73 N
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 13)
CREEK
MILL CREEK
1
2
5
6
11
12
1D
1C
1C3
10C
10C2
10D
10D2
10D3
10E2
1D3
22D2
22C2
24D2
60D2
33D
9B
12B
509B
220
212
212+
133
133+
430
Mile
5,000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

6

N

POTTAWATTAMIE COUNTY

R 41 W.

T 73 N

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 14)

Scale 1:15 840

1 Mile

5 000 Feet

0 1 000 2 000 3 000 4 000 5 000

7

N

1 Mile

5 000 Feet

Scale 1:15 840

MILLS COUNTY, IOWA — SHEET NUMBER 8

8

N

1 Mile

5,000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

POTTAWATTAMIE COUNTY

R. 40 W

T. 73 N

MONTGOMERY COUNTY

RIVER

NISHNABOTNA

WEST

waler

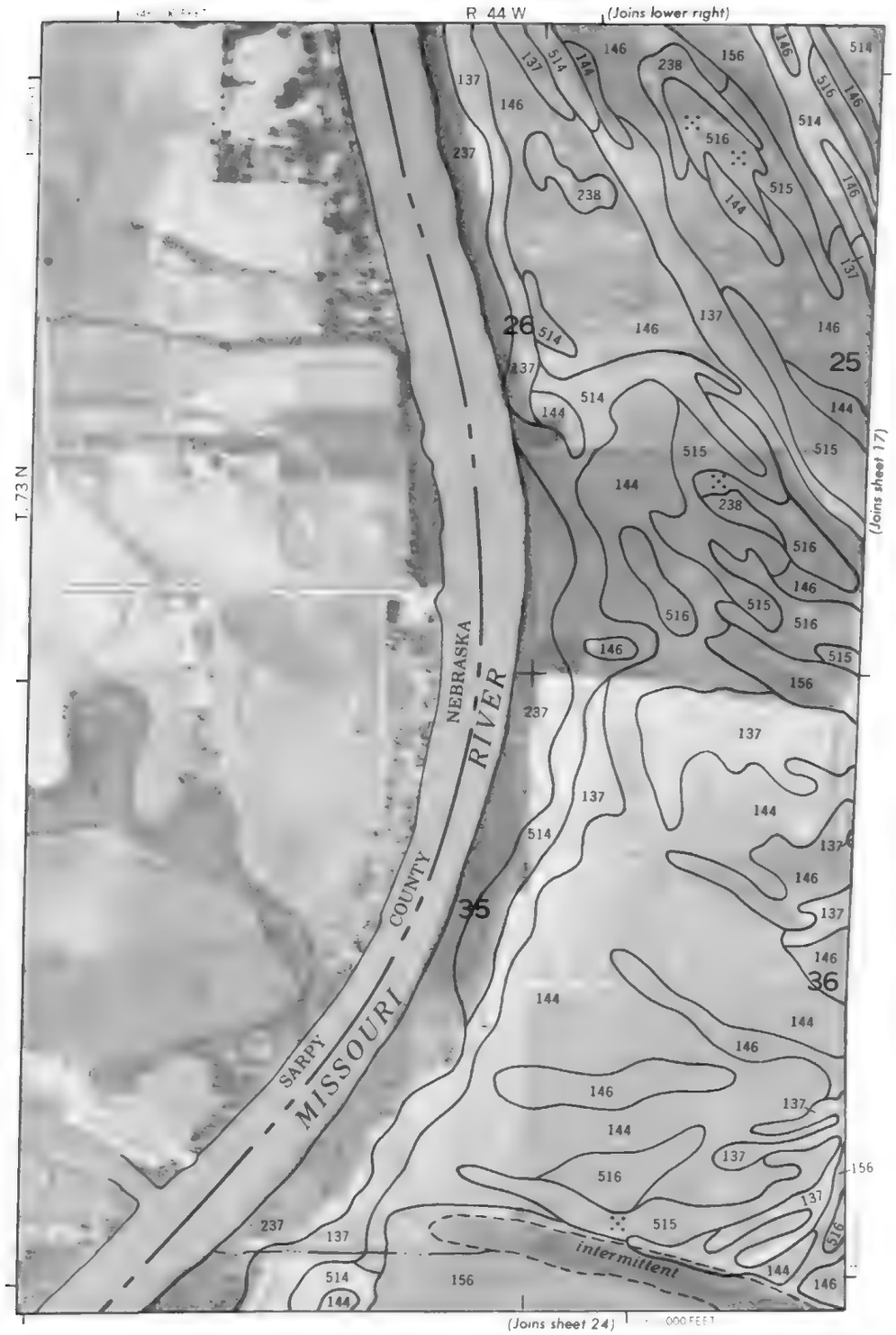
CREEK

FARM

10 Henderson

(Joins sheet 7)

(Joins sheet 16)


R 44 W
(Joins lower right)
T. 73 N
(Joins sheet 17)
26
25
35
36
SARPY
MISSOURI
COUNTY
NEBRASKA
RIVER
intermittent
(Joins sheet 24)


R 44 W
(Joins sheet 1)
T. 73 N.
(Joins sheet 10)
14
13
23
24
SARPY
MISSOURI
COUNTY
NEBRASKA
RIVER
Ditch
(Joins upper left)

9
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

10

N

1 Mile

5 000 Feet

R. 44 W. | R. 43 W.

(Joins sheet 2)

(Joins sheet 9)

(Joins sheet 17)

(Joins sheet 11)

T. 73 N.

Scale 1:15 840

0 0 1/4 1 000 1/2 2 000 3/4 3 000 1 4 000 5 000

Marys

St.

Ditch

int

intermittent

NORTHERN

BURLINGTON

water

13 18 17 16 24 19 20 21

N

R 43 W | R 42 W

T 73 N

(Joins sheet 3)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

1 M i.

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

12

N

(Joins sheet 4)

R 42 W

(Joins sheet 11)

(Joins sheet 19)

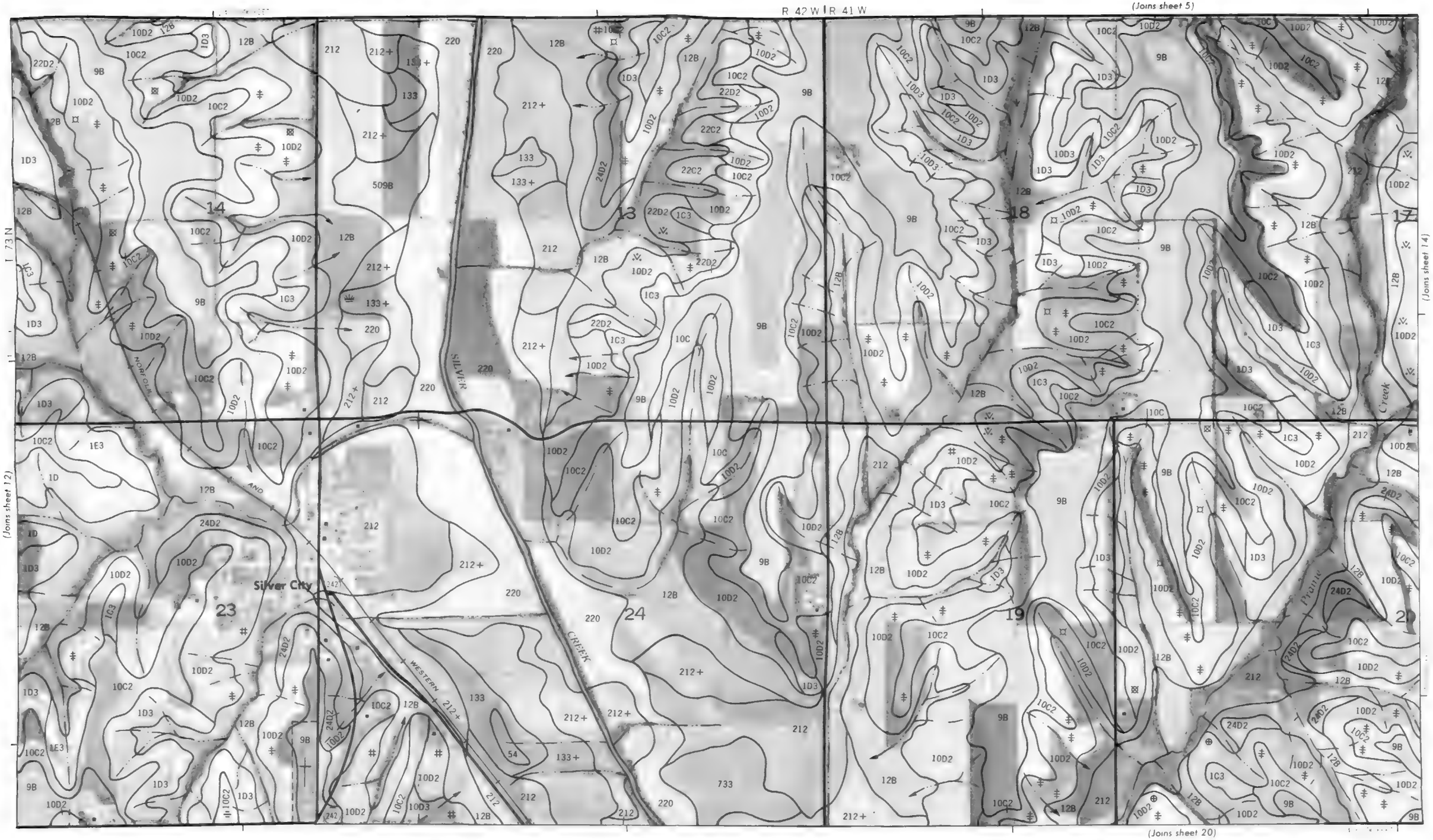
(Joins sheet 13)

T 73 N

Scale 1 15 840

Miles

1 000 Feet



13

N

1 Mile

5,000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1,000 2,000 3,000 4,000 5,000

MILLS COUNTY, IOWA — SHEET NUMBER 14

14

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 6)

R 41 W

T. 73 N.

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 21)

16

15

14

21

22

23

20

Mud Creek

MILLS COUNTY, IOWA — SHEET NUMBER 15

15

N

R. 41 W. R. 40 W.

T. 73 N.

(Joins sheet 14)

(Joins sheet 7)

(Joins sheet 16)

(Joins sheet 22)

Mud Creek

NISHNABOTNA RIVER

WEST

13 18 17 16 24 19 20 21

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 410 000 FEET

1 000 2 000 3 000 4 000 5 000

16

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 8)

220 220 133

R. 40 W.

1 475 000 FEET

T. 73 N.

MONTGOMERY COUNTY

410 000 FEET

(Joins sheet 15)

(Joins sheet 23)

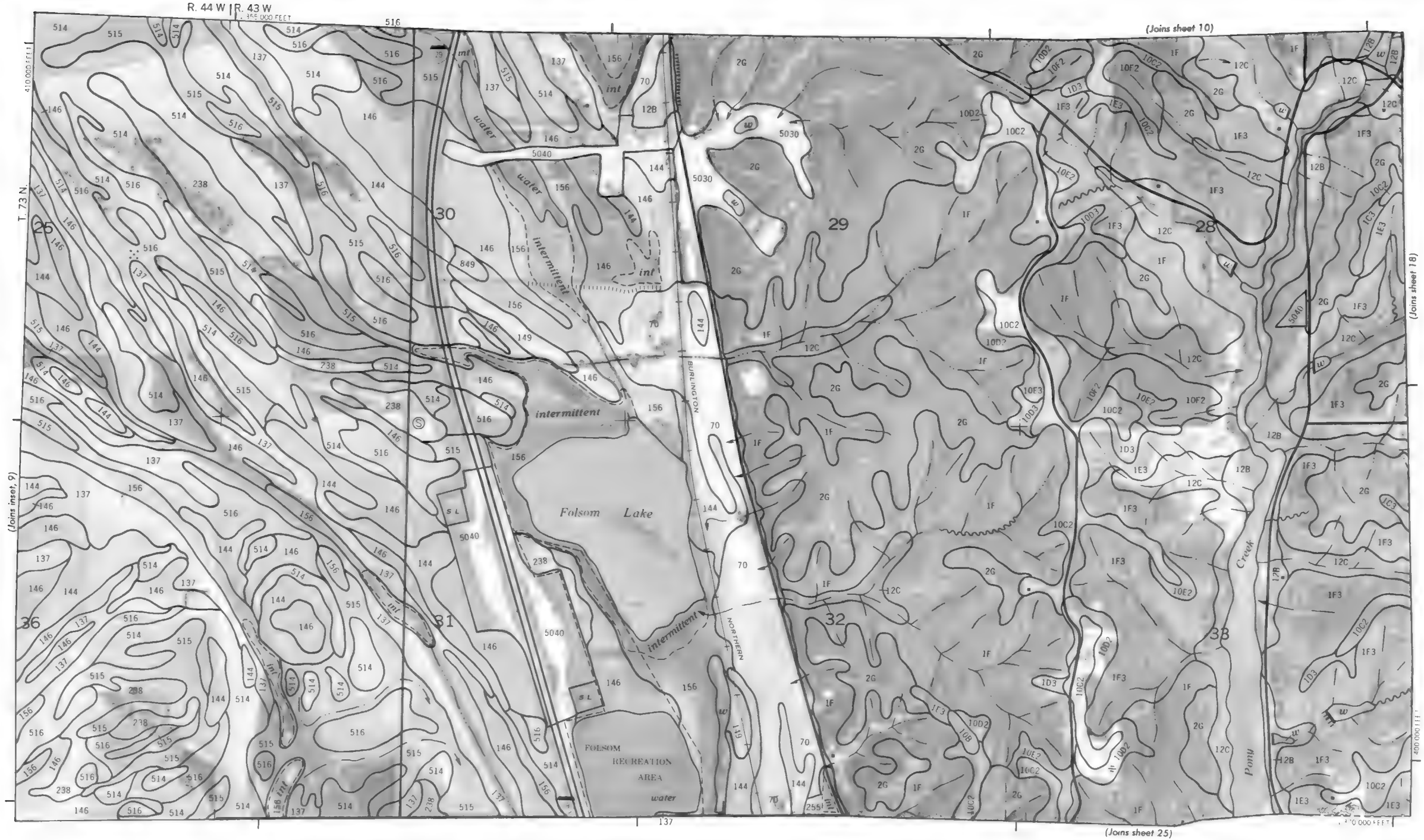
1 465 000 FEET

16 15 14 13 21 22 23 24

FARM CREEK

NORTHERN

BURLINGTON



17

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

18

N

1 Mile

5 000 feet

Scale 1:15 840

0 0 1 000 2 000 3 000 4 000 5 000

R. 43 W. R. 42 W.

73 N.

(Joins sheet 17)

(Joins sheet 19)

(Joins sheet 26)

water

25 26 30 31 34 35 36

MILLS COUNTY, IOWA — SHEET NUMBER 19

19

N

R 42 W

(Joins sheet 12)

(Joins sheet 20)

(Joins sheet 18)

(Joins sheet 27)

T 73 N

Muller Creek

Muller Creek

water

1 Mile

5000 Feet

Scale 1:15 840

20

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 13)

R. 42 W. | R. 41 W.

1 425 000 FEET

T. 73 N.

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 28)

1 410 000 FEET

400 000 FEET

405 000 FEET

Prairie

Creek

Creek

Creek

Osborne

SILVER

AND

WEST

NORFOLK

26 25 30 29 35 36 31 32


21
N
(Joins sheet 14)
R 41 W.
T. 73 N.
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 29)
29
28
27
26
32
33
34
35
Osborne
Creek
Little
Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾

22

N

1 Mile

5000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 15)

R 41 W | R 40 W

T 73 N

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 30)

25 30 29 28 36 31 32 33

WILLOW SLOUGH

intermittent water

intermittent

APPROXIMATE BOUNDARY

RIVER

NISHNABOTNA

WEST Creek

Mud Creek

NORTHERN BURLINGTON

N

1 Mile

5,000 Feet

Scale 1:15 840

1 R. 40 W.

T. 73 N.

(Joins sheet 16)

(Joins sheet 22)

(Joins sheet 31)

MONTGOMERY COUNTY

WILLOW SLOUGH

Douglas Creek

28 27 26 25

33 34 35 36

24

N

R. 44 W.

(Joins inset, sheet 9)

1 350 000 FEET

T. 72 N.

SARPY COUNTY NEBRASKA

MISSOURI RIVER

PLATTE RIVER

CASS COUNTY NEBRASKA

water

intermittent

11

12

(Joins sheet 25)

1 335 000 FEET

(Joins sheet 32)

395 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

MILLS COUNTY, IOWA — SHEET NUMBER 25

25

N

R. 44 W. | R. 43 W. | 1 355 000 FEET

T. 72 N.

305 000 FEET

(Joins sheet 24)

(Joins sheet 17)

(Joins sheet 26)

(Joins sheet 33)

1 365 000 FEET

1 115 000 FEET

POLSOM'S RECREATION AREA

PONY CREEK PARK

HURLINGTON

NORTHERN

Pacific City

intermittent

water

Creek

1 Mile

5 000 Feet

Scale 1:15 840

26

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

R. 43 W. R. 42 W.

1 395 000 FEET

T. 72 N.

395 000 FEET

(Joins sheet 18)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 34)

GLENWOOD
(county seat)

Mile Hill Lake

212 CREEK

NORTHERN BURLINGTON

1 370 000 FEET

N

R 42 W

(Joins sheet 19)

T 72 N

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 35)

Balfour

Balfour

BURLINGTON NORTHERN

BURLINGTON NORTHERN

1 Mile

5,000 Feet

Scale 1:15,840

28

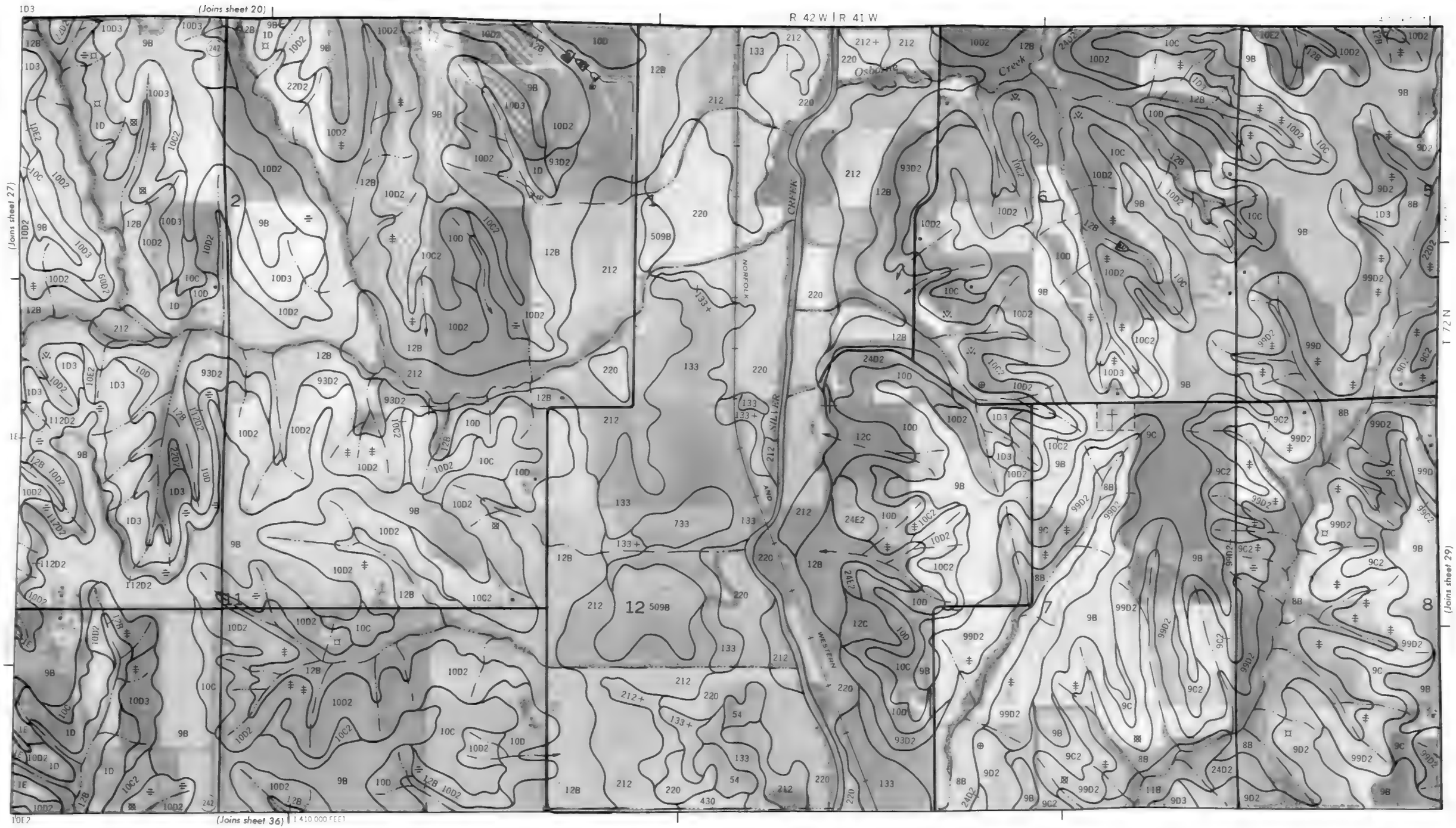
N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 000 2 000 3 000 4 000 5 000



29

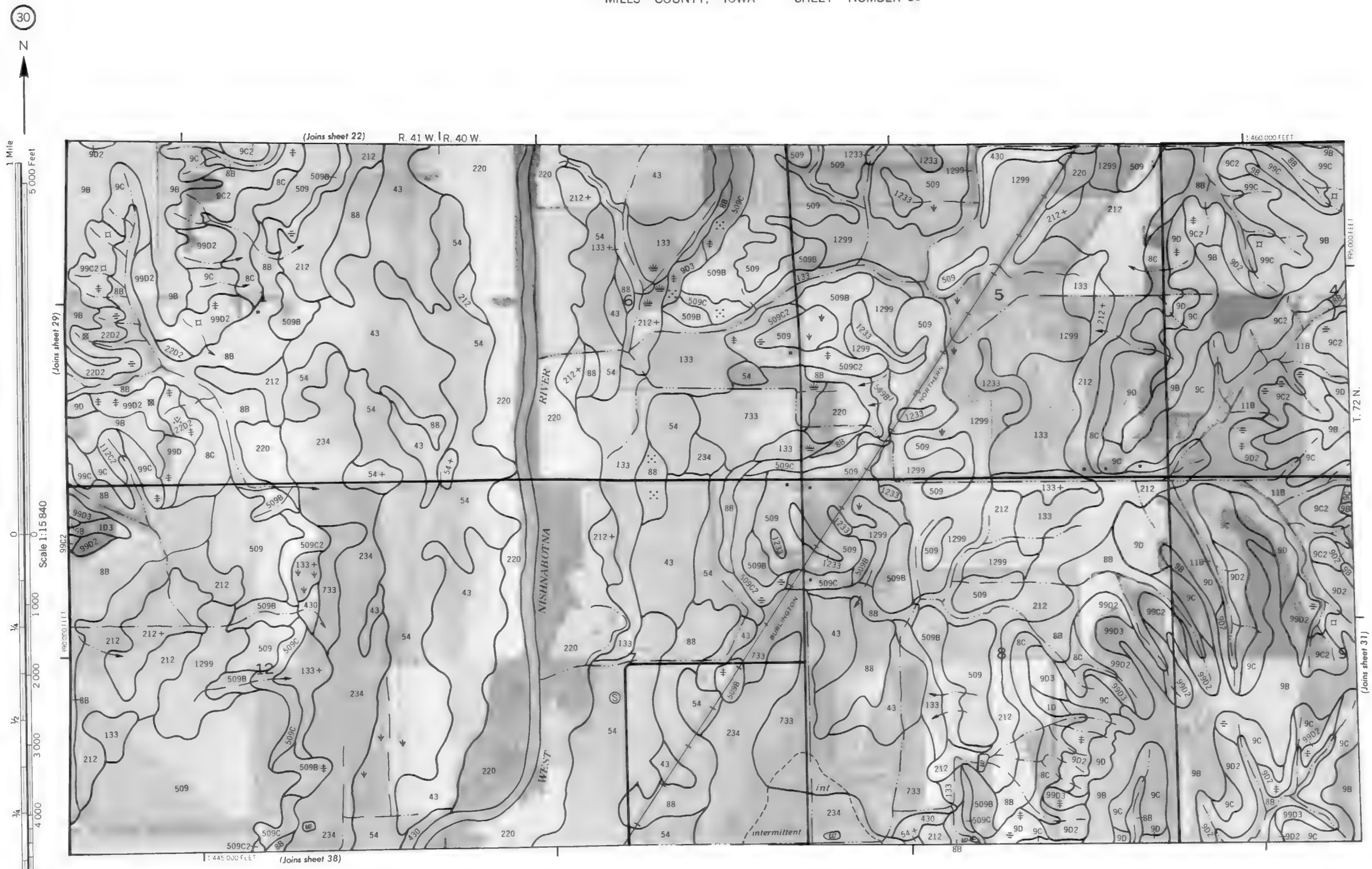
N

1 Mile

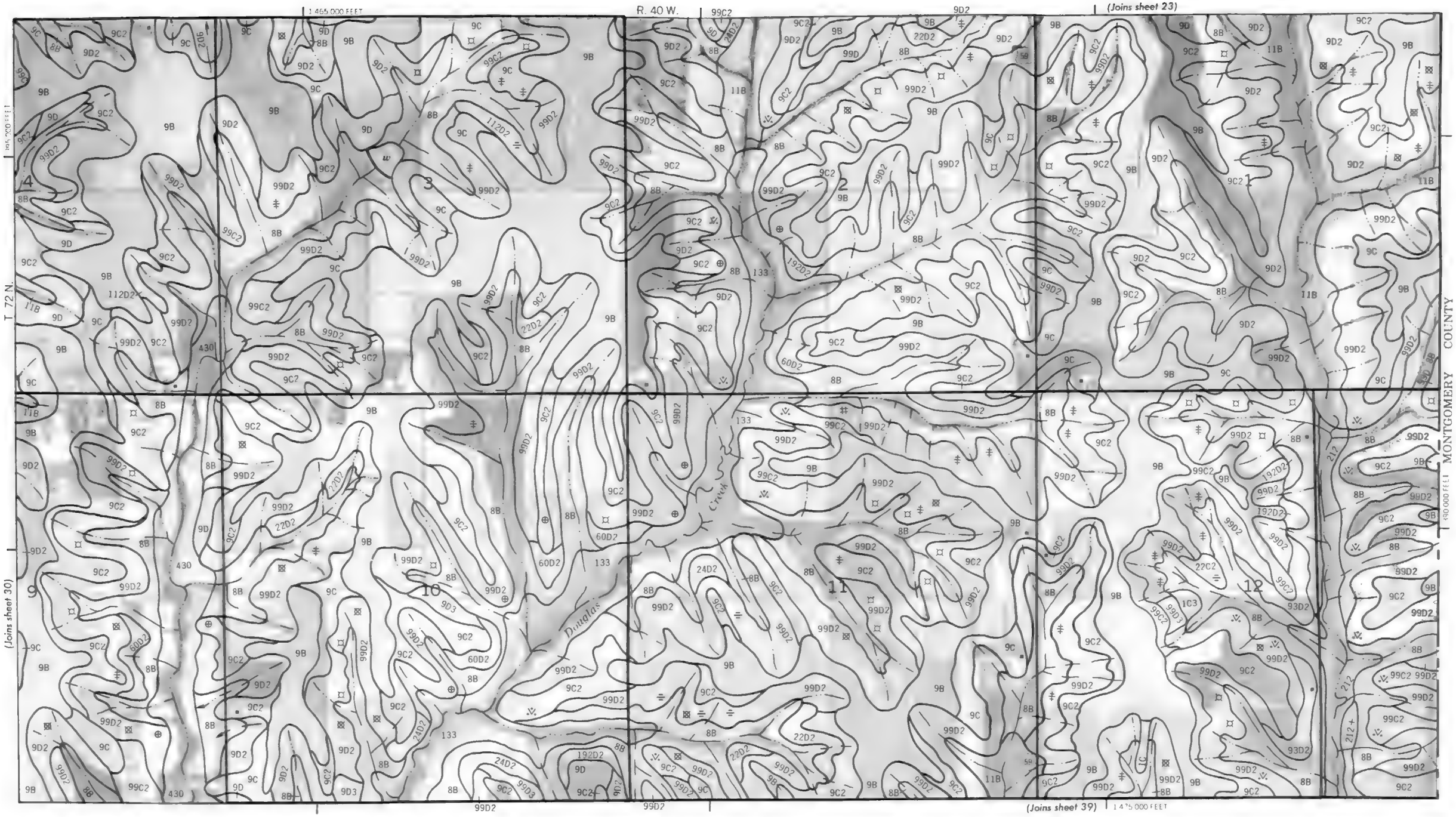
5 000 Feet

Scale 1:15 840

MILLS COUNTY, IOWA — SHEET NUMBER 30



MILLS COUNTY, IOWA — SHEET NUMBER 31



31

N

1 Mile

5 000 Feet

Scale 1:15 840

32

N

1 Mile

5,000 Feet

0 1,000 2,000 3,000 4,000 5,000

Scale 1:15 840

(Joins lower right) R. 44 W.

T. 72 N.

26

25

36

CASS COUNTY

NEBRASKA

MISSOURI RIVER

BURLINGTON NORTHERN

(Joins sheet 40)

10,000 feet

4000 AND 5000 FOOT GRID TICKS

(Joins sheet 24) R. 44 W.

14

13

24

23

CASS COUNTY NEBRASKA

MISSOURI RIVER

T. 72 N.

(Joins sheet 33)

(Joins upper left)

MILLS COUNTY, IOWA — SHEET NUMBER 33

33

N

R 44 W | R 43 W

T 72 N

(Joins sheet 25)

(Joins sheet 34)

(Joins sheet 32)

(Joins sheet 40)

13 18 17 16

24 19 20 21

Ditch

Eaton

Creek

Ditch

Pony

BURLINGTON

NORTHERN

water

water

Pacific Junction

1 Mile

5,000 Feet

Scale 1:15 840


34
N
(Joins sheet 26)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 41)
R. 43 W. | R. 42 W.
T. 72 N.
GLENWOOD
(County Seat)
GLENWOOD STATE SCHOOL
SEWAGE LAGOON
KEG CREEK
BURLINGTON NORTHERN
water
Scale 1:15 840
1 Mile
5 000 Feet

MILLS COUNTY, IOWA — SHEET NUMBER 35

35

N

R. 42 W.

1 390 000 FEET

717

(Joins sheet 27)

(Joins sheet 36)

(Joins sheet 34)

(Joins sheet 42)

T. 72 N.

water

Waubonsie Creek

1 Mile

5 000 Feet

Scale 1:15 840

36

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

(Joins sheet 28)

R. 42 W. | R. 41 W.

1 420 000 FEET

(Joins sheet 35)

(Joins sheet 43) | 1 410 000 FEET

(Joins sheet 37)

T. 72 N.

385 000 FEET

190 000 FEET

13 14 17 18 19 20 23 24

BURLINGTON NORTHERN SILVER CREEK NORFOLK AND WESTERN BURLINGTON NORTHERN

MILLS COUNTY, IOWA — SHEET NUMBER 37

37

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

1,425,000 FEET

R. 41 W.

(Joins sheet 29)

T. 72 N.

18° 00' FEET

(Joins sheet 38)

(Joins sheet 36)

Little Creek

Little Creek

WISHNABOTNA RIVER

WEST NORTHERN

BURLINGTON

17 16 15 14

20 21 22 23

99C2

(Joins sheet 44)

1,440,000 FEET

38

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 30)

R. 41 W. | R. 40 W.

(Joins sheet 37)

(Joins sheet 45)

(Joins sheet 39)

T. 72 N.

RIVER

NISHNABOTNA

WEST

Indian Creek

intermittent

NORTHERN BURLINGTON

Hastings

water

13

18

17

16

24

19

20

21

N

1 Mile

5 000 Feet

Scale 1:15 840

1 465 000 FEET

385 000 FEET

T. 72 N.

R. 40 W.

(Joins sheet 31)

(Joins sheet 38)

(Joins sheet 46)

380 000 FEET

1 475 000 FEET

MONTGOMERY COUNTY

16

15

14

13

21

22

23

24

Douglas Creek

Indian Creek

Emerson

BURLINGTON NORTHERN

40

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 44 W. | R. 43 W.

(Joins sheet 33)

(Joins sheet 32)

(Joins sheet 47)

(Joins sheet 41)

1 365 000 FEET

1 375 000 FEET

1 370 000 FEET

1 355 000 FEET

T. 72 N.

25 30 29 28 31 32 33 36

NORTHERN

BURLINGTON

water

intermittent

int

Ditch

Eaton Creek

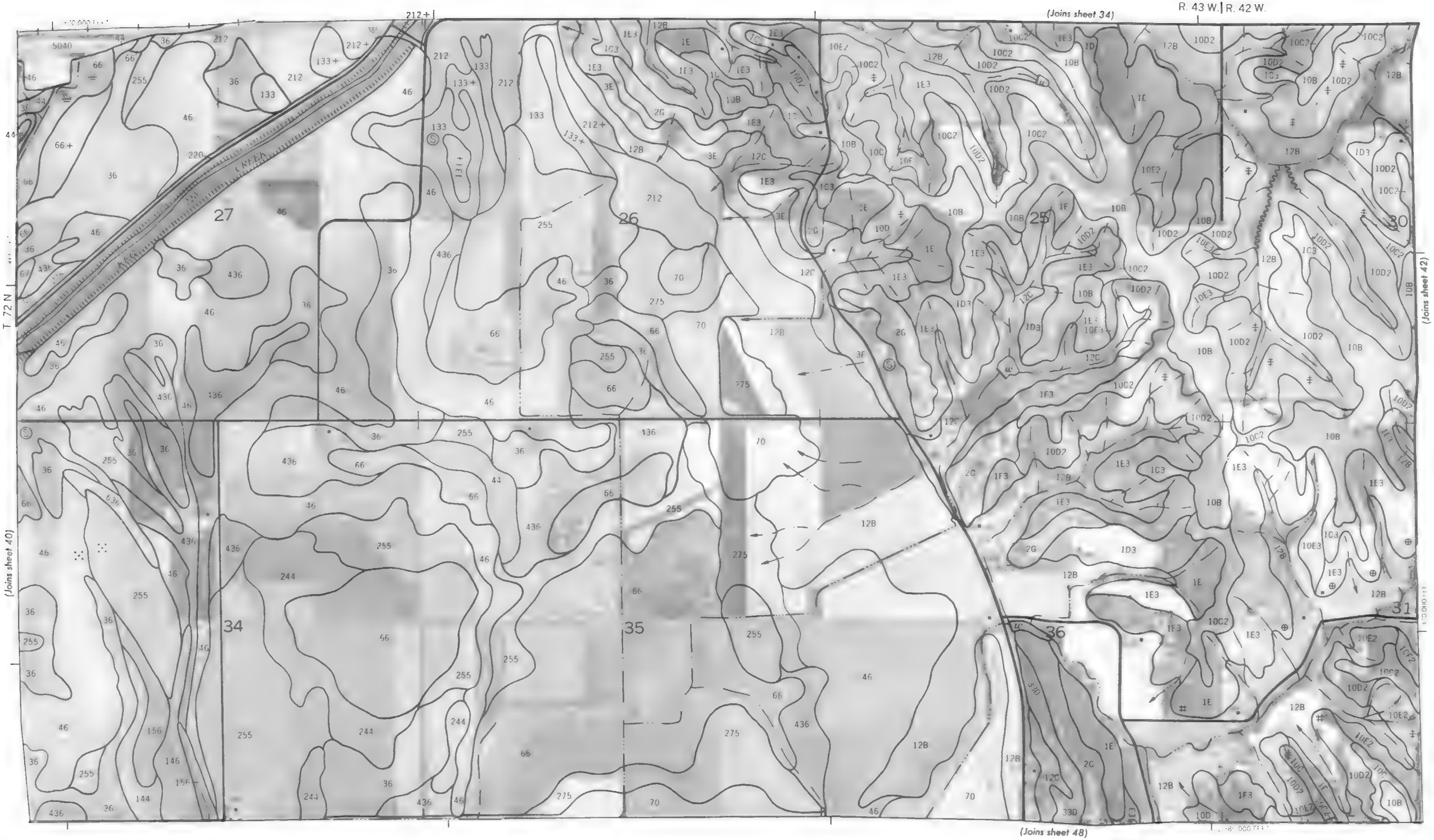
Dairy Ditch

CRLEA

MISSOURI RIVER

CASS COUNTY NEBRASKA

MILLS COUNTY, IOWA — SHEET NUMBER 41



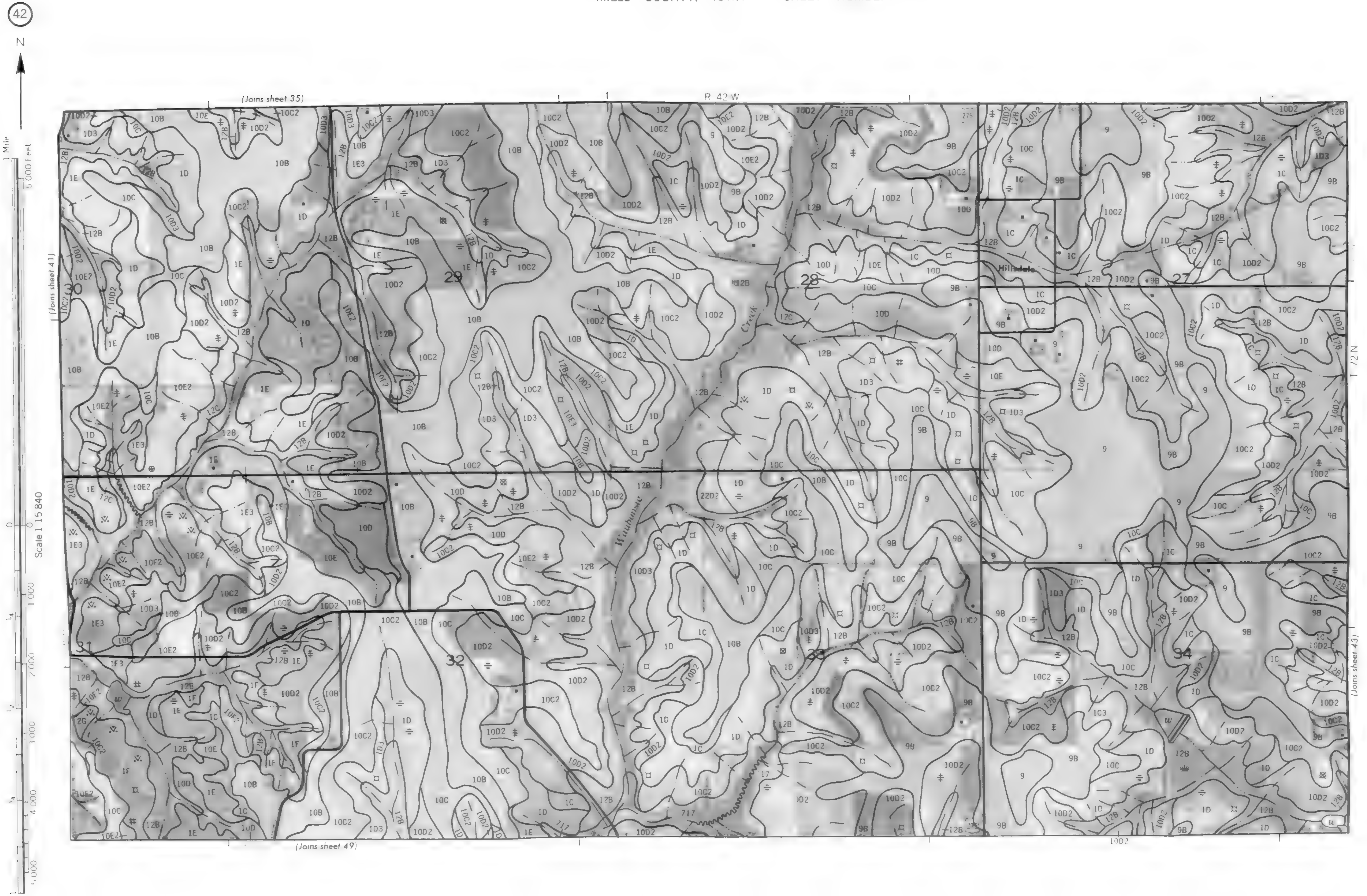
41

N

1 Mile

5000 Feet

Scale 1:15 840

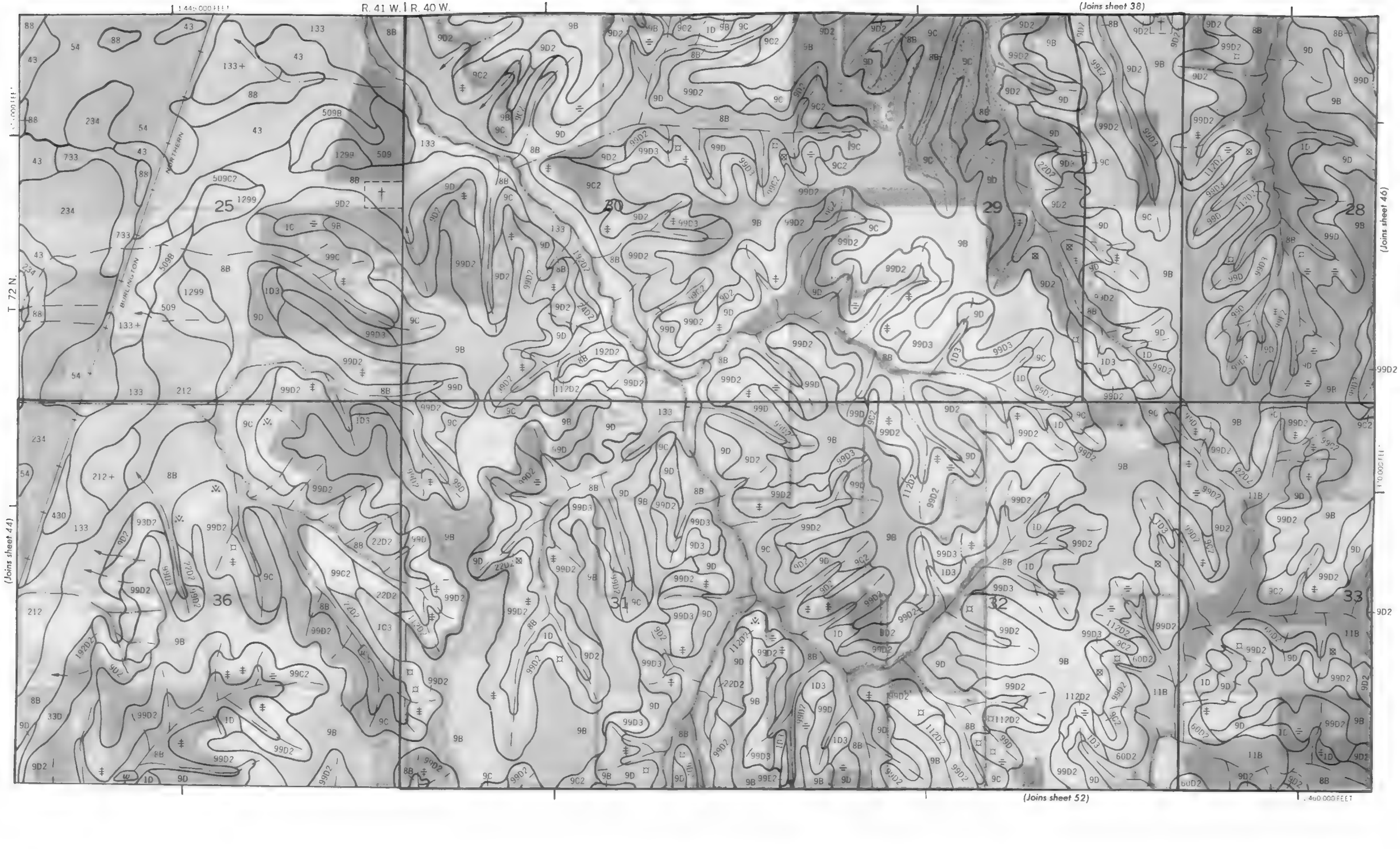

42
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 35)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 49)
R. 42 W.
T. 72 N.
Hillsdale
Waubonsie Creek
29
28
27
30
31
32
33
34


R 42 W
R 41 W
(Joins sheet 36)
T 72 N.
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 50)
26
25
30
29
35
36
31
32
NORFOLK AND WESTERN
SILVER
MALVERN
Little Creek
CREEK
SEWAGE LAGOON
43
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


(Joins sheet 37)
R. 41 W.
(Joins sheet 43)
MALVERT
BURLINGTON
NORTHERN
RIVER
NISHNABOTNA
WEST
T. 72 N.
29
28
27
26
32
33
34
35
1 440 000 FEET
1 425 000 FEET
(Joins sheet 51)
(Joins sheet 45)

1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

MILLS COUNTY, IOWA — SHEET NUMBER 45



46

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 39)

R 40 W

Emerson

Indian Creek

BURLINGTON NORTHERN

(Joins sheet 45)

T 72 N

MONTGOMERY COUNTY

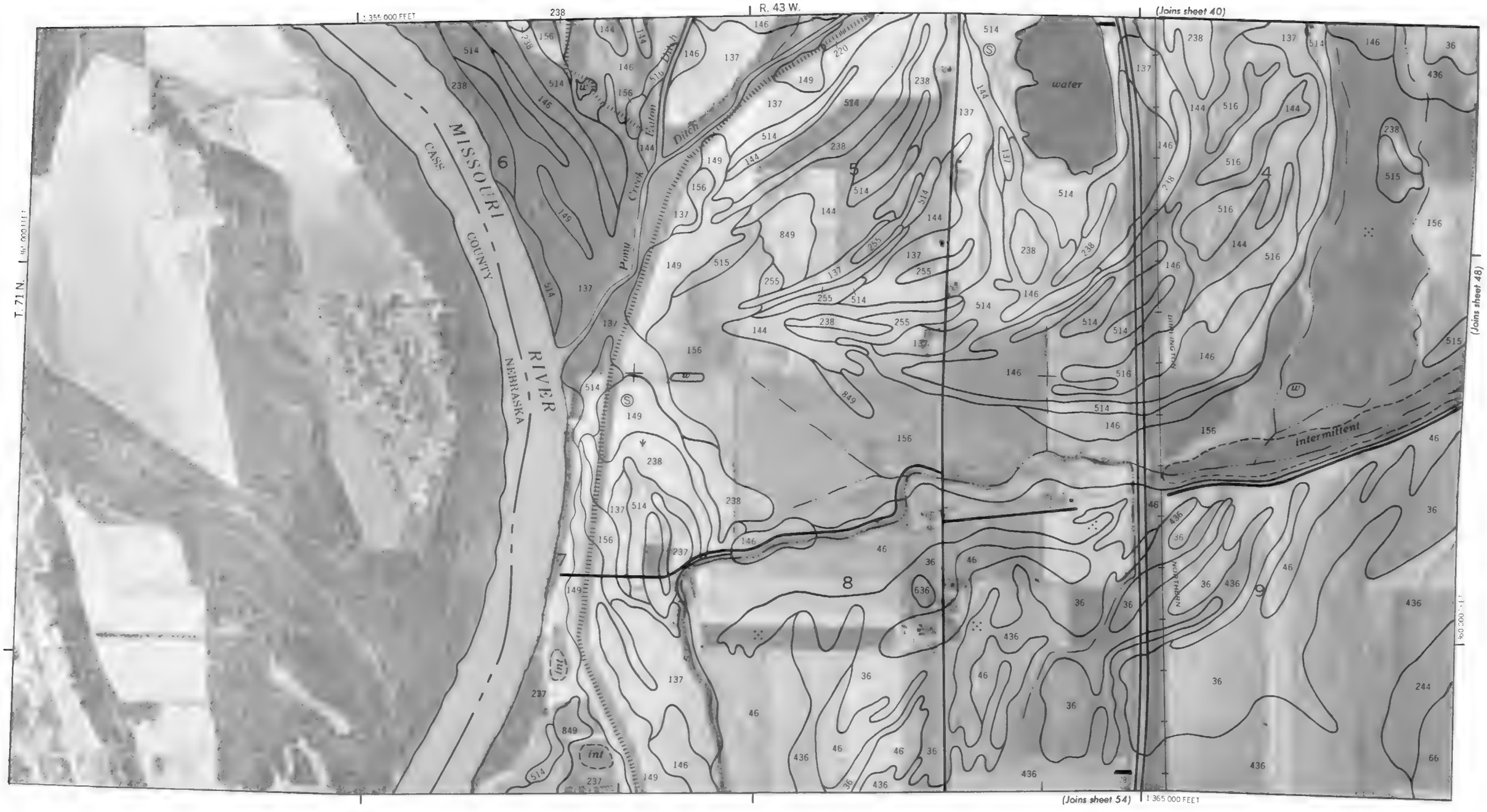
(Joins sheet 53)

N

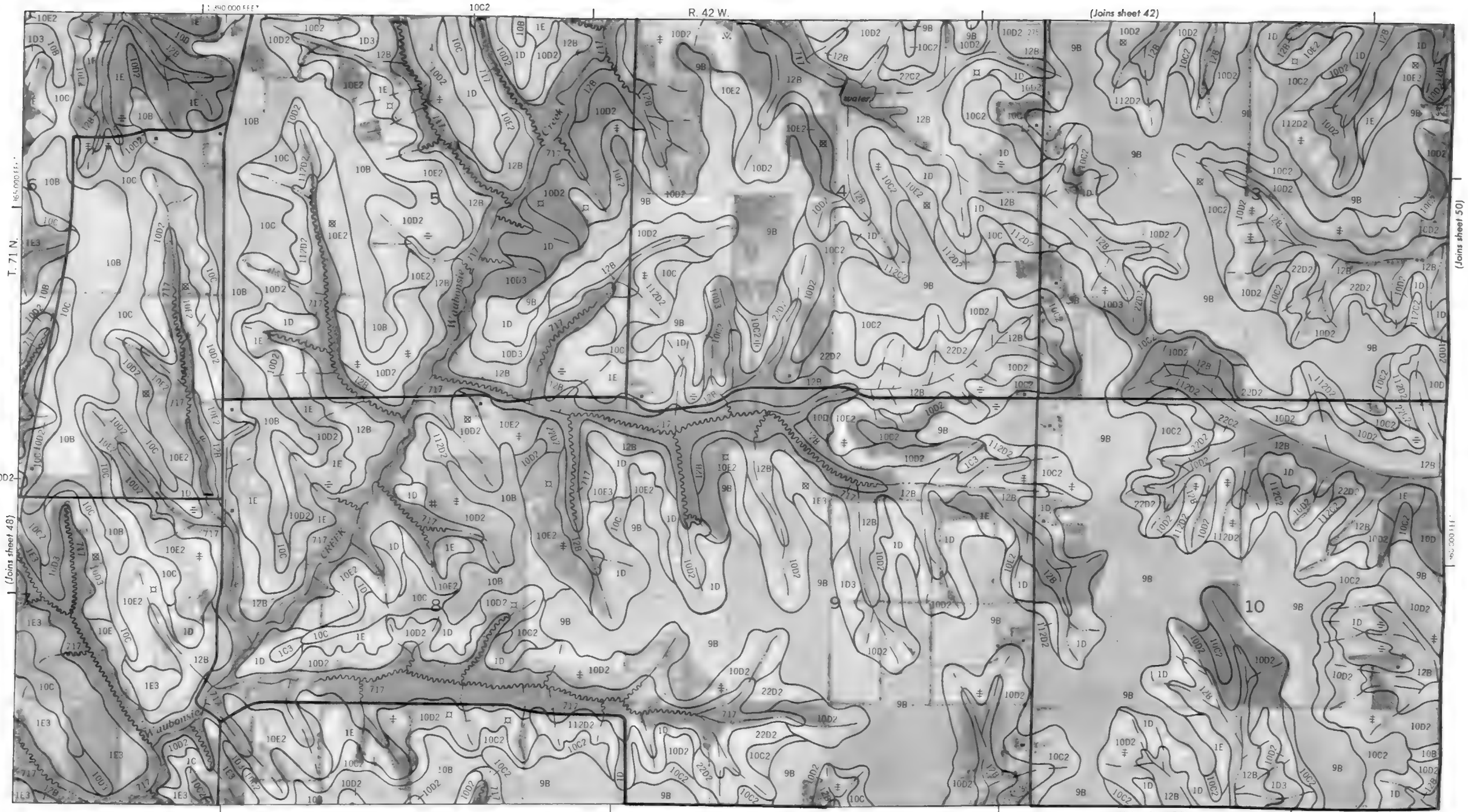
1 Mile

5 000 Feet

Scale 1:15 840




48
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
R. 43 W.
R. 42 W.
1 385 000 FEET
1 370 000 FEET
T. 71 N.
(Joins sheet 41)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 55)
intermittent
10
11
12
1
2
3
6
7



49

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

50

N

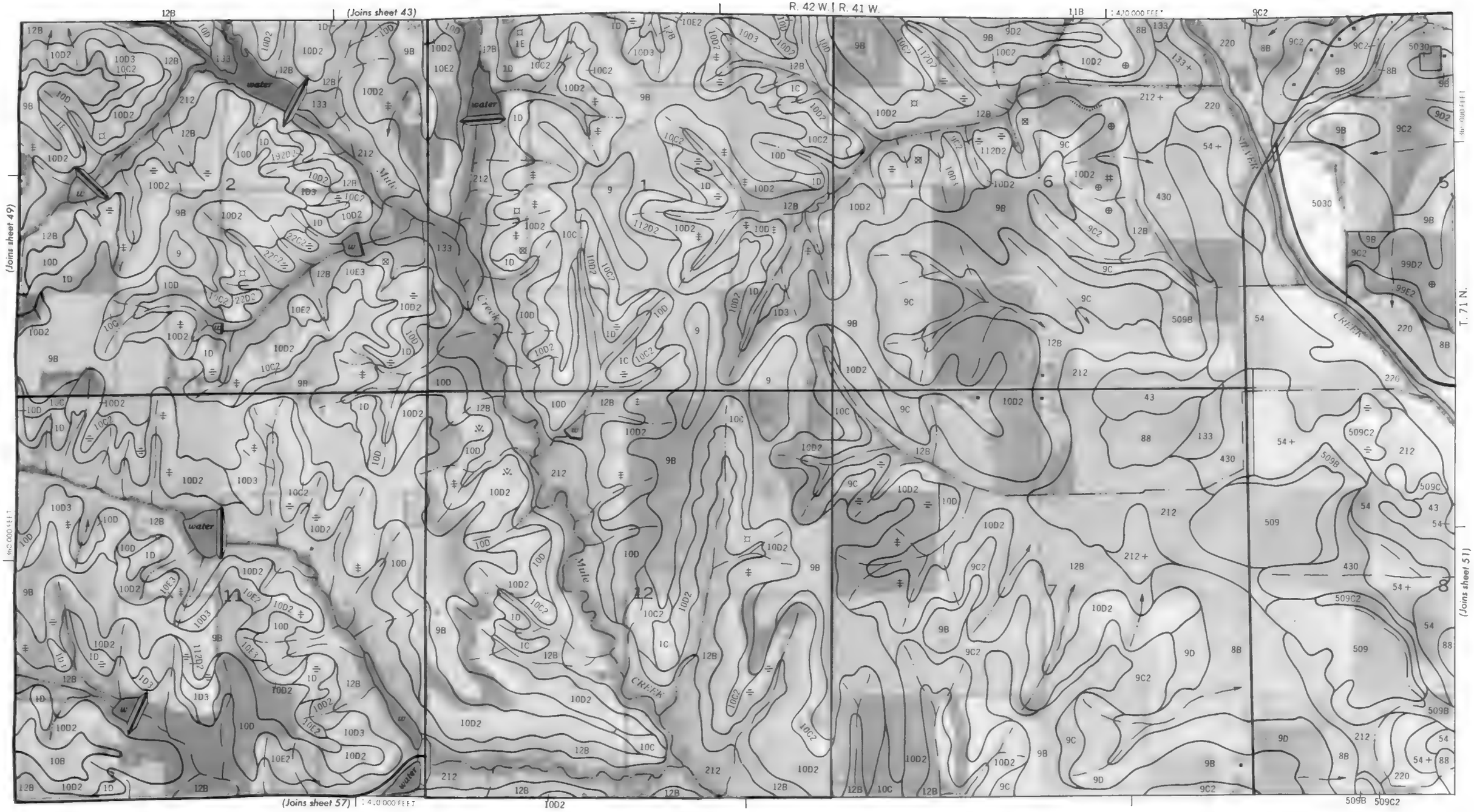
1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000



MILLS COUNTY, IOWA — SHEET NUMBER 51

51

N

R 41 W

(Joins sheet 44)

T 71 N

(Joins sheet 52)

(Joins sheet 50)

(Joins sheet 58)

NORFOLK AND WESTERN

NISHNABOTNA RIVER

NORTHERN

BURLINGTON

SILVER CREEK

10 WEST

Scale 1:15 840

52

N

1 Mile

5 000 Feet

(Joins sheet 45)

R. 41 W. | R. 40 W.

T. 71 N.

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 59)

1 460 000 FEET

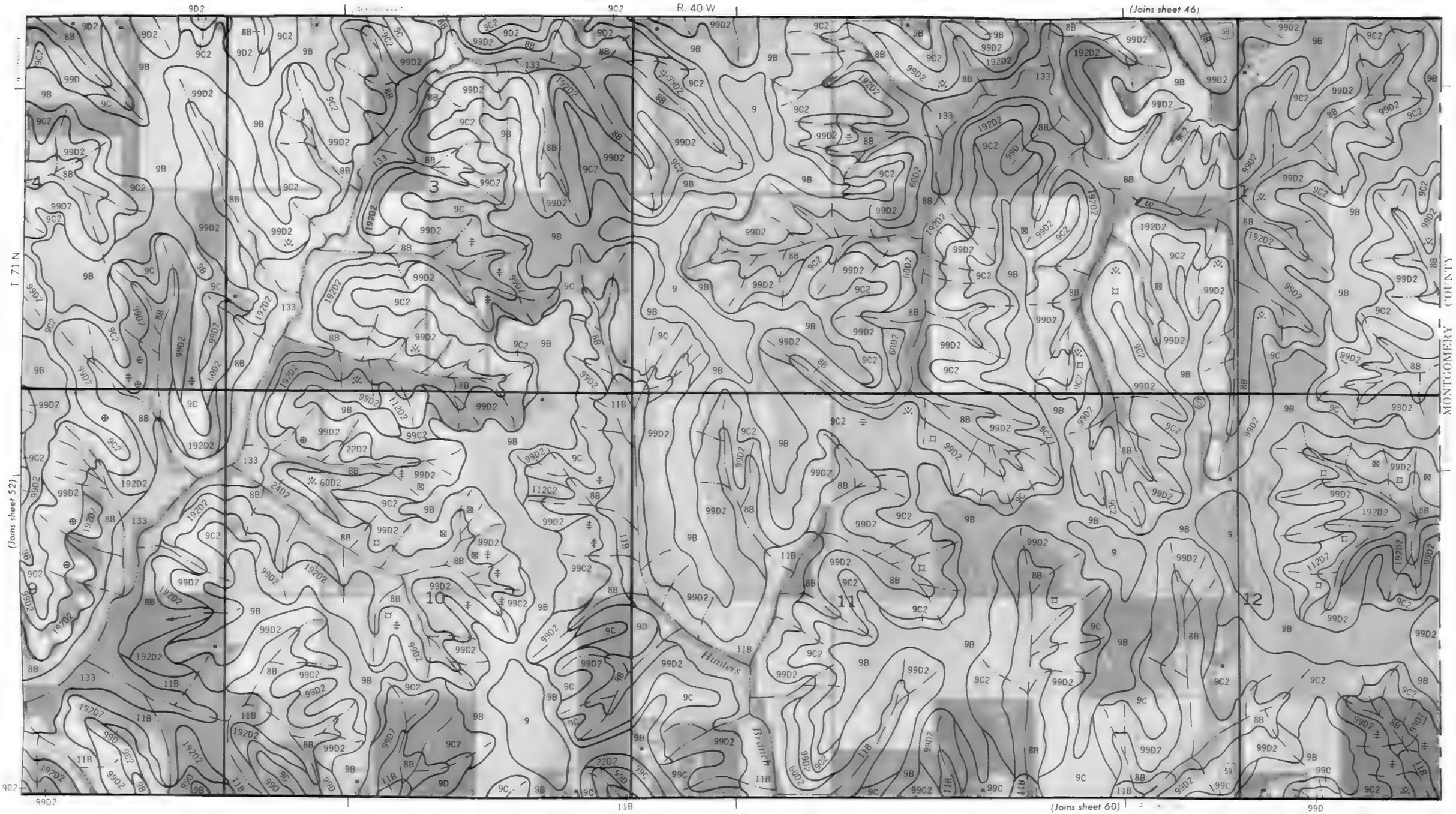
1 445 000 FEET

360 000 FEET

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

1/4 1/2 3/4



53

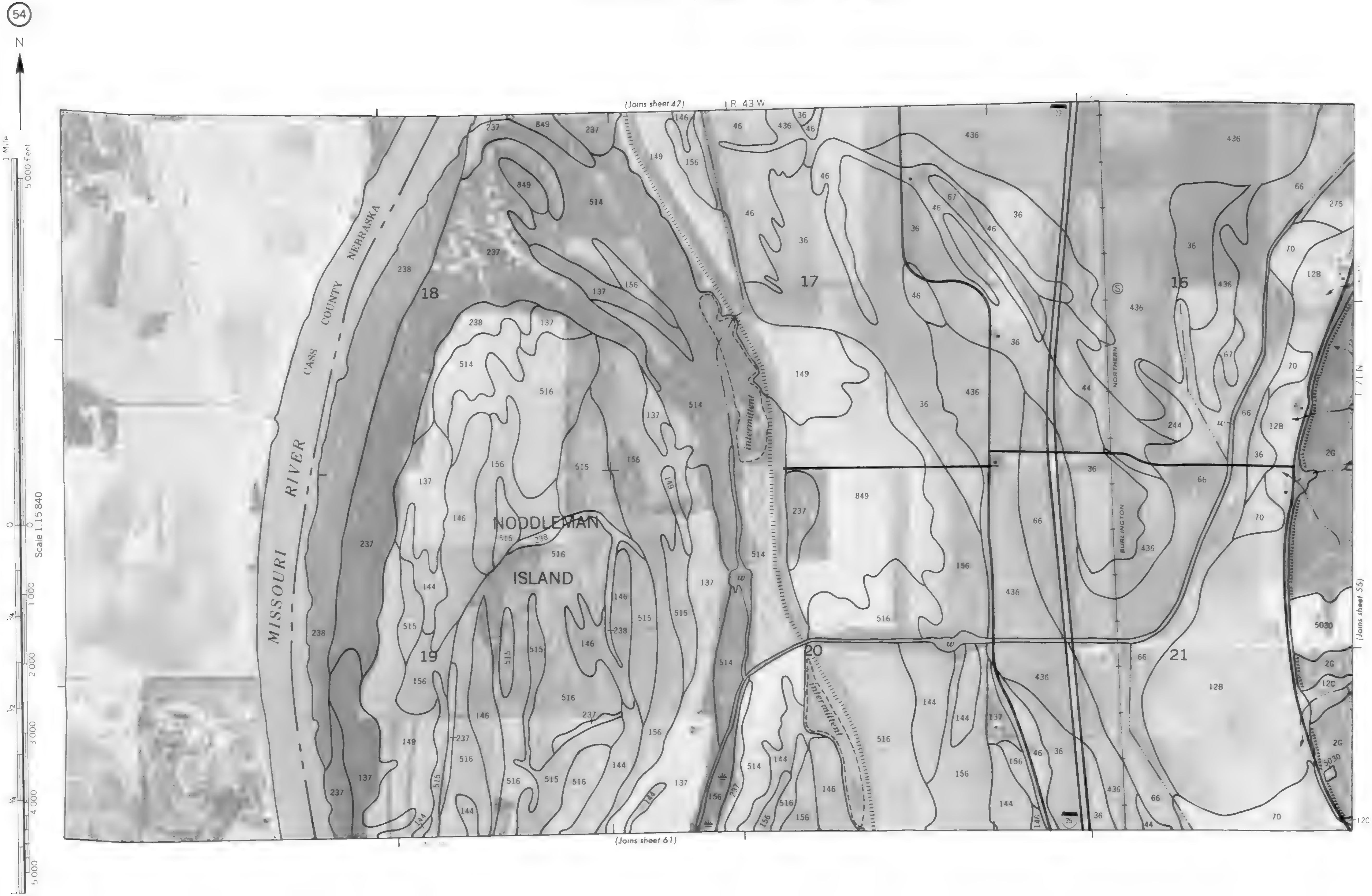
N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1 000 2 000 3 000 4 000 5 000


54
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 47)
R 43 W
(Joins sheet 61)
(Joins sheet 55)
T 71 N
MISSOURI RIVER
CASS COUNTY NEBRASKA
NODDLEMAN ISLAND
intermittent
BURLINGTON
NORTHERN
16
17
18
19
20
21

55

N

R. 43 W. | R. 42 W.

(Joins sheet 48)

(Joins sheet 56)

(Joins sheet 54)

(Joins sheet 62)

T 71 N

1 Mile

5,000 Feet

Scale 1:15 840

Creek

MILLS COUNTY, IOWA — SHEET NUMBER 56

56

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

(Joins sheet 49)

(Joins sheet 55)

(Joins sheet 63)

(Joins sheet 57)

R. 42 W.

T. 71 N.

Waubonsie Creek

McPherron Creek

Spring Valley Creek

275

N

R 42 W | R 41 W

T 71 N

(Joins sheet 50)

(Joins sheet 58)

(Joins sheet 56)

(Joins sheet 64)

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

58

N

Scale 1:15 840

1 Mile 5 000 Feet

0 0

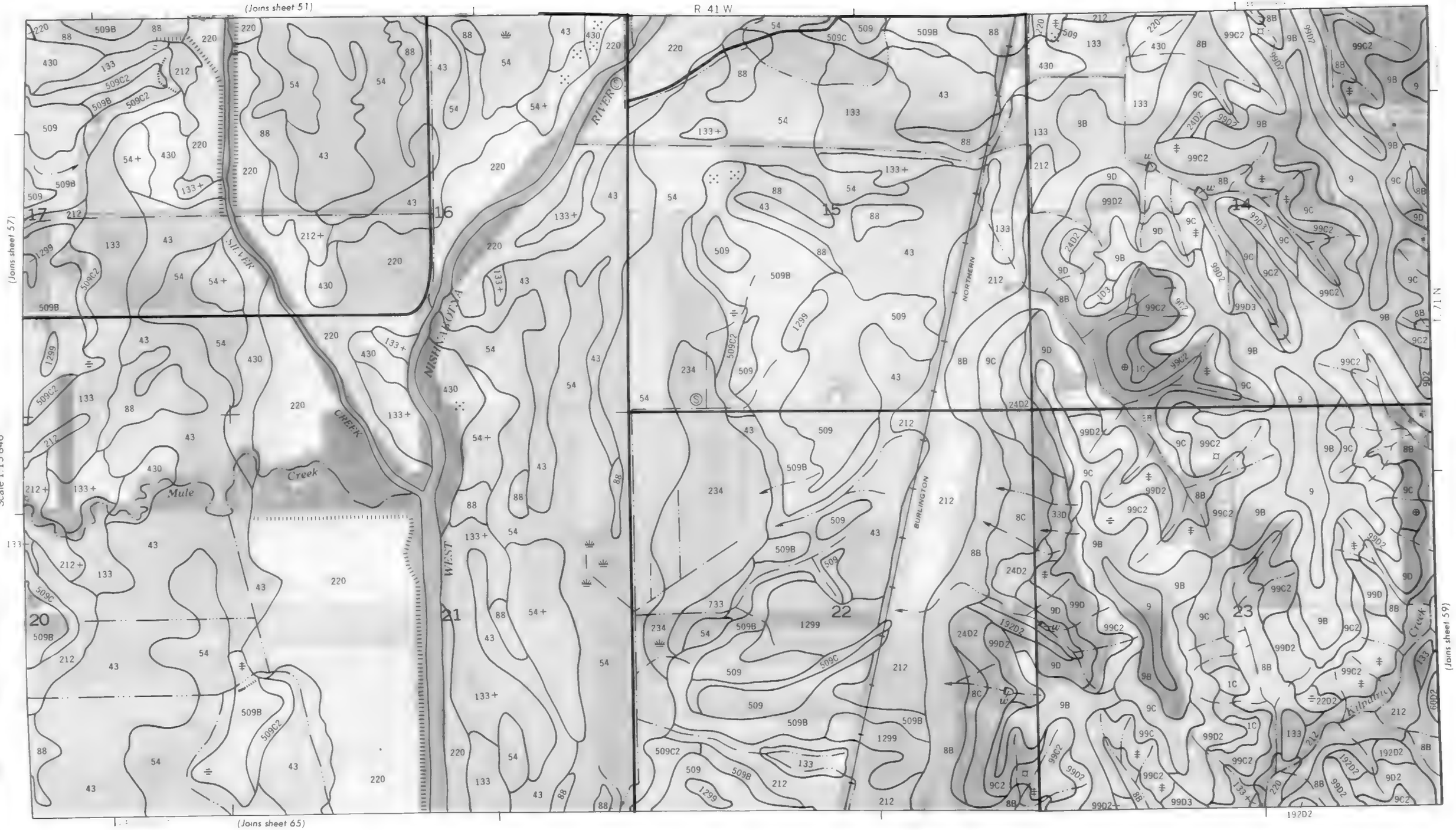
1/4 1 000

1/2 2 000

3/4 3 000

4 000

1 5 000



59

N

R 41 W | R. 40 W

T 71 N

(Joins sheet 52)

(Joins sheet 60)

(Joins sheet 58)

(Joins sheet 66)

Strahan

Creek

Deer

Scale 1:15 840

1 Mile

5,000 Feet

MILLS COUNTY, IOWA — SHEET NUMBER 60

60

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 000 2 000 3 000 4 000 5 000

(Joins sheet 53)

R 40 W.

T 71 N

MONTGOMERY COUNTY

(Joins sheet 59)

(Joins sheet 61)

(Joins sheet 67)

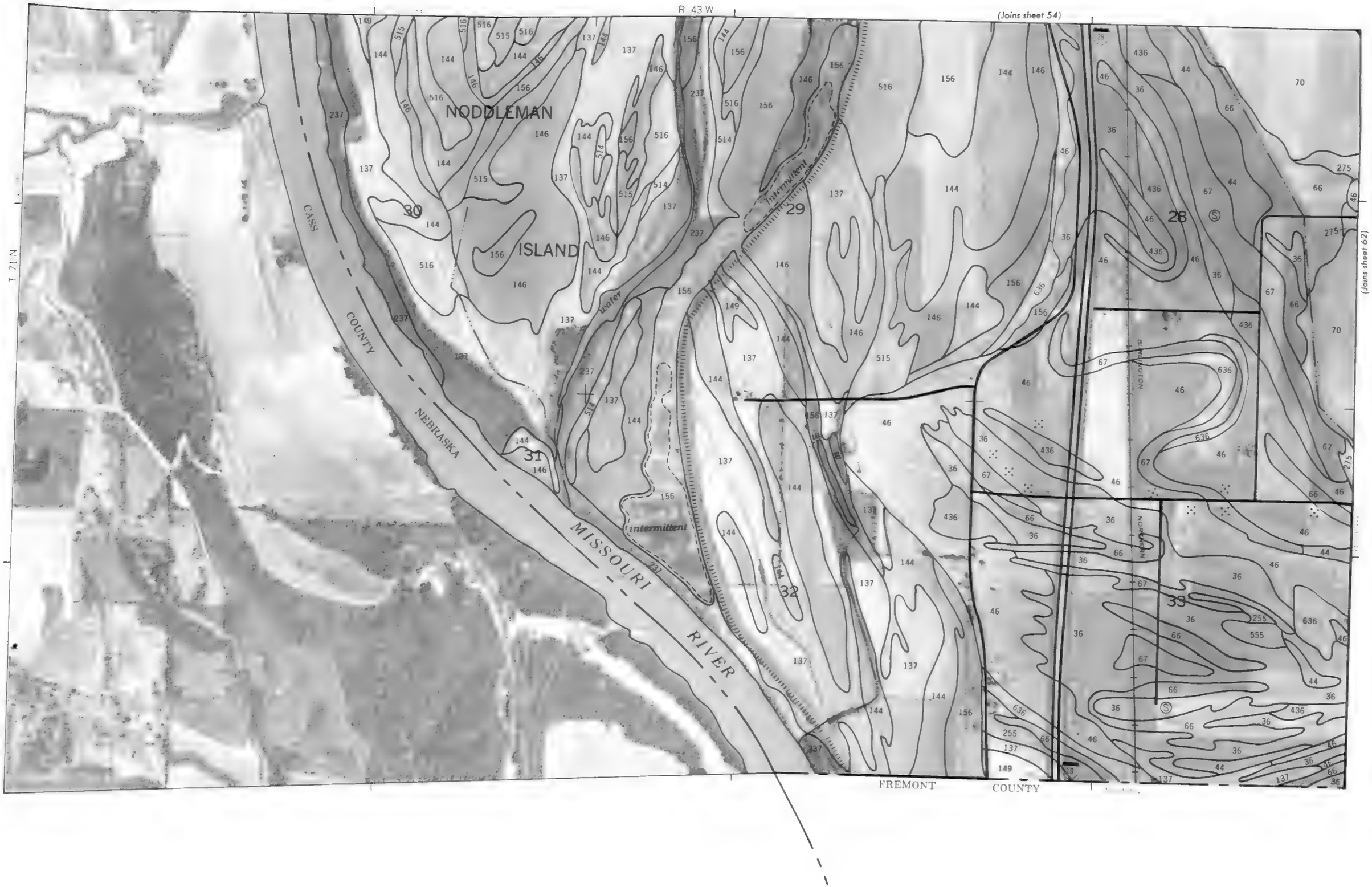
16 15 14 13

21 22 23 24

Hunters Branch

Hunters Branch

MILLS COUNTY, IOWA — SHEET NUMBER 61



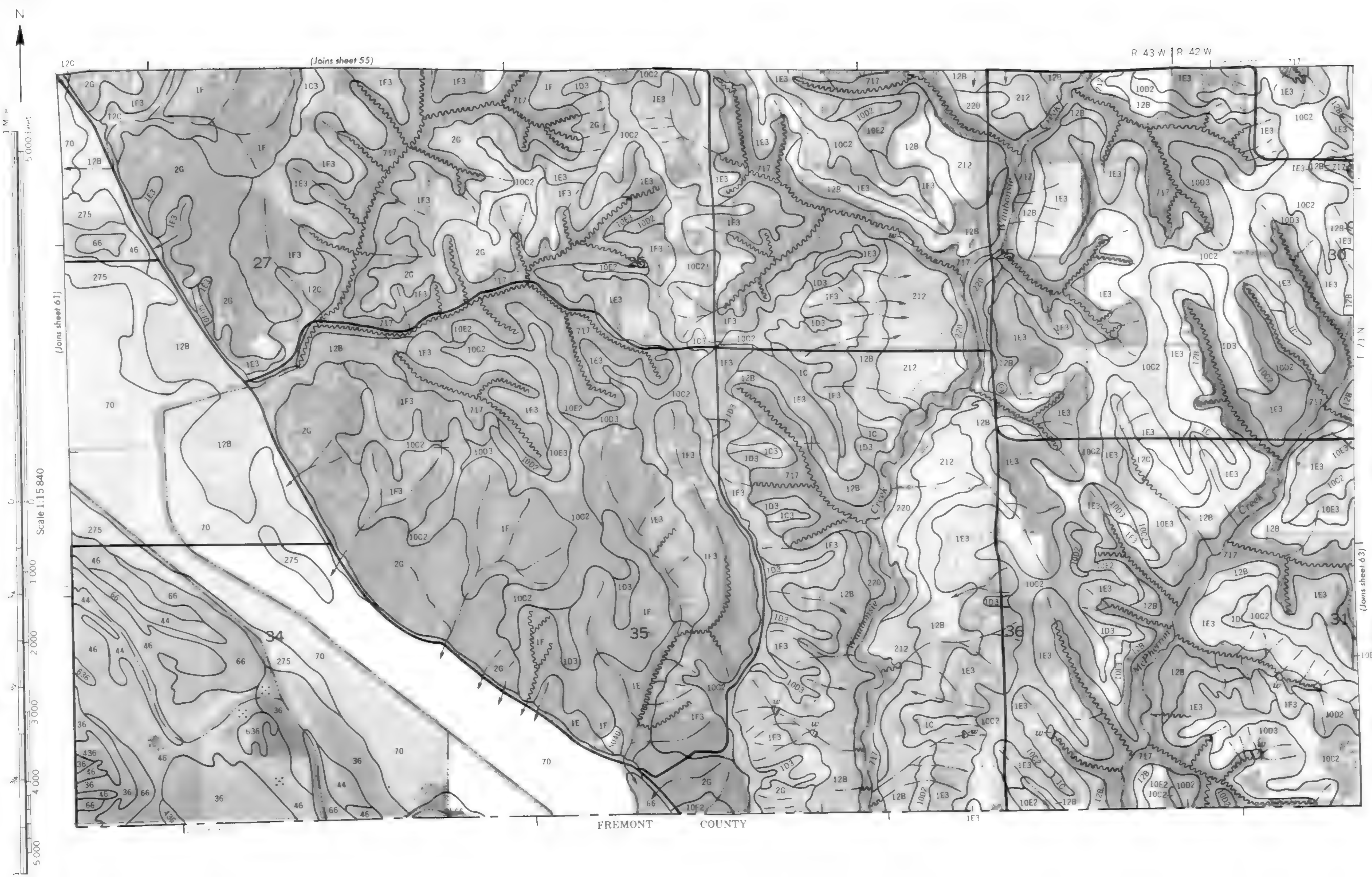
61

N

1 Mile

5 000 Feet

Scale 1:15 840


N
(Joins sheet 55)
(Joins sheet 61)
(Joins sheet 63)
R 43 W | R 42 W
T 71 N
27
26
25
30
34
35
36
31
Waubonsie Creek
McPherson Creek
FREMONT COUNTY
Scale 1:15 840
1 Mile
5 000 Feet

63

N

R 42 W

T 71 N

(Joins sheet 56)

(Joins sheet 64)

(Joins sheet 72)

McPherson Creek

Tabor

FREMONT COUNTY

1 Mile

5,000 Feet

Scale 1:15 840

MILLS COUNTY, IOWA — SHEET NUMBER 64

64

N

(Joins sheet 57)

R. 42 W. | R. 41 W.

1 420 000 FEET

(Joins sheet 63)

T. 71 N.

(Joins sheet 65)

1 410 000 FEET

FREMONT COUNTY

Scale 1:15 840

1 Mile

5 000 Feet

340 000 FEET

Spring Valley Creek

26 25 30 29 35 36 31 32

9B 10C2 10D2 12B 10D3 112C2 1D3 24D2 10E2 1E3 112D2 10C 10E 212 5030 w 9C 509B 43 8B 88 133+ 733 220 234 54+ 54 133 430


1 425 000 FEET
R. 41 W.
(Joins sheet 58)
1 345 000 FEET
T. 71 N.
29
28
27
26
32
33
34
35
RIVER
NORTHERN
BURLINGTON
Creek
NISHNABOTNA
Spring Valley Creek
WEST
Kilpatric
(Joins sheet 64)
(Joins sheet 66)
1 340 000 FEET
1 440 000 FEET
FREMONT COUNTY

N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

MILLS COUNTY, IOWA — SHEET NUMBER 66

66

N

1 Mile

5 000 Feet

(Joins sheet 65)

R. 41 W. | R. 40 W.

(Joins sheet 59)

460 000 FEET

440 000 FEET

1 445 000 FEET

T. 71 N.

(Joins sheet 67)

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

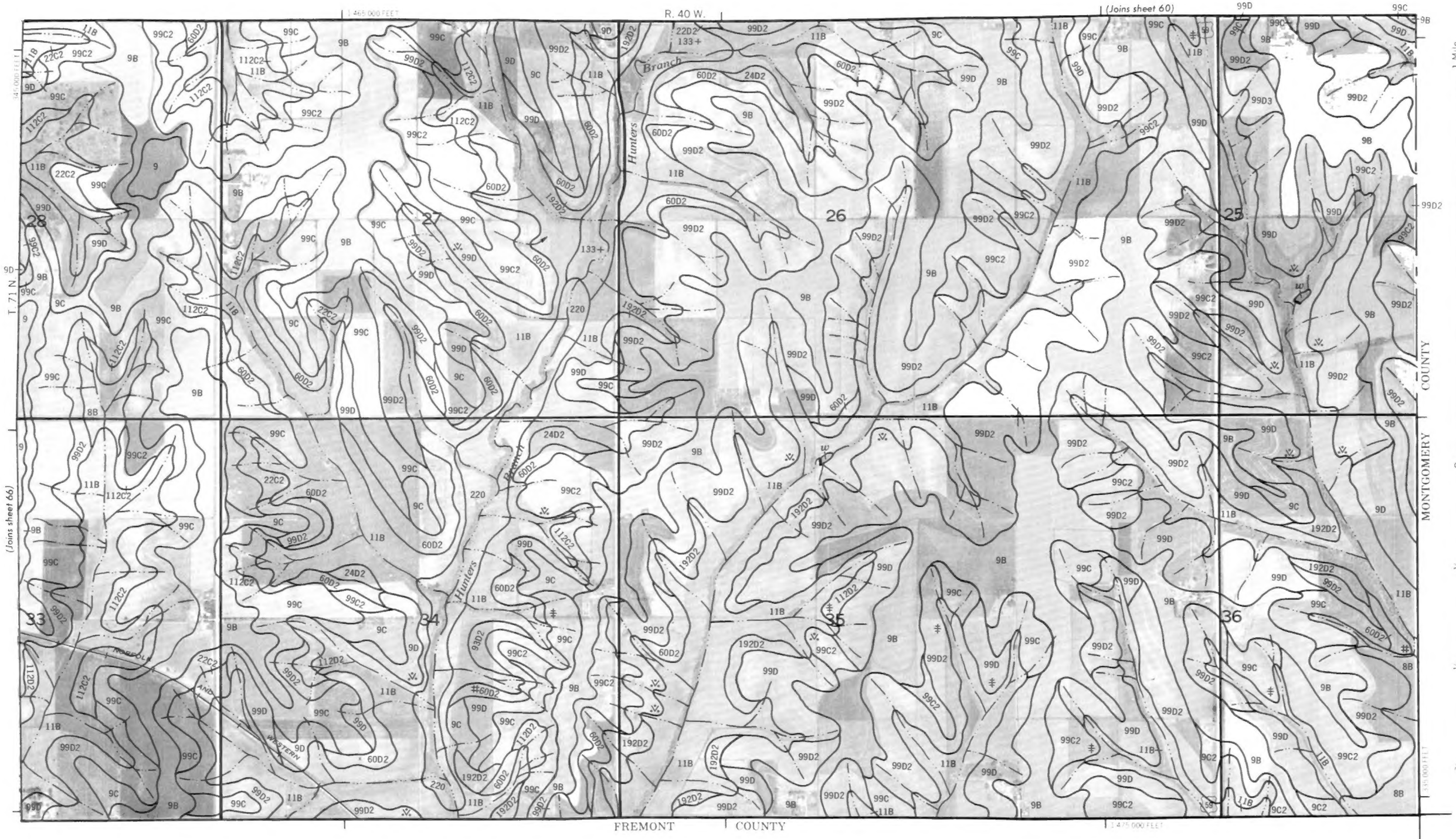
25 30 29 28

36 31 32 33

Deer Creek

NORFOLK AND WESTERN

FREMONT COUNTY


N
1 Mile
5 000 Feet
Scale 1:15 840
1 465 000 FEET
R. 40 W.
(Joins sheet 60)
T. 71 N.
(Joins sheet 66)
Hunters Branch
Hunters Branch
MONTGOMERY COUNTY
FREMONT COUNTY
1 475 000 FEET
28
27
26
25
33
34
35
36
NORFOLK AND WESTERN